NICHOLS NEW GRADED LESSONS IN ARITHMETIC

BOOK SIX

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NEW GRADED LESSONS

IN

ARITHMETIC

BOOK VI

BY

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PREFACE

This sixth book of the series follows the same general plan as the preceding books.

All the operations in common and decimal fractions, as well as those of bills and accounts, which were presented in Book V, are again presented here in such a manner that any pupil who failed to master those subjects then, may have another opportunity to do so.

The new work consists of a presentation of denominate numbers, including their applications to the measurements of angles, boards, carpets, circles, rooms, triangles, etc. The pupils are given practice in pacing and estimating the larger measures of distance, as well as approximating the area of surfaces and the volume of solids.

The work in percentage is made a little more complicated, and simple interest is presented for the first time. Those methods only are given which allow the pupils to solve orally many problems.

No formal study of algebra is given, but the pupils are made acquainted with the symbol x and the equation, and are urged to use them in all problems where the algebraic method of solution is the simpler, and the arithmetical solution complicated.

Attention is again called to the importance of oral work, and to the number of lessons especially designed for that purpose. Urge the pupils to solve orally as many problems as possible in every lesson.

Since a thorough mastery of any subject comes only from repetition, many review exercises are given so that the pupils may be able to rely upon themselves and learn to work independently.

The problems have been carefully selected, and made as practical as the experiences of the pupils will allow.

With pleasure the author acknowledges his indebtedness to all who have assisted by suggestions, but especially to Miss Mabel L. Gessner, teacher of Domestic Science in the Eaton District, New Haven, who planned the lessons devoted to Domestic Science, and to Miss Sarah E. Briggs, principal of the Skinner School, New Haven, and to Miss Isabella J. Ray, of the Emerson School, Boston, Mass., who read the manuscript and suggested improvements.

WILBUR F. NICHOLS.

NEW HAVEN, January, 1910.

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NEW GRADED LESSONS IN ARITHMETIC

Book VI

Lesson 1. *ORAL REVIEW*

Add:

1. 7	**2.** 17	**3.** 27	**4.** 37	**5.** 47	**6.** 57
9	9	9	9	9	9

In examples like the following train the pupils to *think quickly* 17 and 9 are 26; 26 and 20 are 46, but to *say* 17 and 29 are 46. Give frequent practice in work of this kind.

7. 17	**8.** 37	**9.** 67	**10.** 77	**11.** 87	**12.** 97
29	19	39	49	59	69

Subtract:

13. 15	**14.** 25	**15.** 35	**16.** 45	**17.** 55	**18.** 65
8	8	8	8	8	8

In examples like the following train the pupils to *think quickly* 35 less 8 are 27; 27 less 10 are 17, but to *say* 35 less 18 are 17. Make charts for the purpose of giving frequent drill in *oral* addition and subtraction of tens and units.

19. 35	**20.** 75	**21.** 85	**22.** 95	**23.** 45	**24.** 65
18	18	38	48	28	38

Add and subtract:

25. 47	**26.** 41	**27.** 33	**28.** 72	**29.** 64	**30.** 81
31	19	18	48	57	46

1. In the number 125, we say 5 is in units' place, 2 is in tens' place, and 1 is in hundreds' place.

2. A **unit** is one thing of any kind, as one foot, one horse, one pencil.

3. A **number** tells how many units are used, as 6 horses, 1 book, 7 feet.

4. Writing numbers by means of symbols or figures is called **Notation.**

5. We use the Arabic system of notation.

6. Why is our system called the Arabic system?

7. Name the ten characters, called figures, by which any number may be represented.

8. In the Arabic system ten units in any place or order make one unit of the next higher place or order.

9. This system of grouping by tens is called a *decimal* system from the Latin word *decem*, meaning *ten*.

10. Reading numbers written in symbols or figures is called **Numeration.**

11. For convenience in reading and writing numbers we separate by commas the figures into groups or periods of three figures each. The right-hand figure of each group gives the name to the period, as units' period, thousands' period, etc.

12. The *place* that any period or figure occupies gives it its *value*. This value is indicated by the name given to the place. Learn the name of each place from the table on the next page.

13. Name the periods in order from units to millions.

14. Name the places in order from units to millions and from units to millionths.

15. How many units make one ten? How many tens make one hundred? How many units make one hundred?

16. What change is made in the value of a figure by moving it one place to the left? What change is made by moving it one place to the right?

17. In which place is a figure written to express millions?

Trillions' Period				Billions' Period				Millions' Period				Thousands' Period				Units' Period				Decimal						
	Trillions			Hundred-billions	Ten-billions	Billions		Hundred-millions	Ten-millions	Millions		Hundred-thousands	Ten-thousands	Thousands		Hundreds	Tens	Units	Decimal Point	Tenths	Hundredths	Thousandths	Ten-thousandths	Hundred-thousandths	Millionths
	2,			6	7	1	,	4	0	8	,	9	1	2	,	0	7	6	.	0	0	0	7	4	5

1. The number above is read, 2 trillion, 671 billion, 408 million, 912 thousand, 76 *and* 745 millionths.

2. In reading numbers read each period as if it stood alone and then add the name of the period. Use the word *and* only in place of the decimal point.

3. Train pupils to read numbers correctly, calling especial attention to such numbers as:

305,000, three hundred five thousand.
.305, three hundred five thousandths.
300.005, three hundred *and* five thousandths.

Read the following numbers:

4. 205.00701
5. 2,071,006,702.00007
6. 24.010220
7. 17,011,715,106,208.012
8. 100,001.001
9. 200,202,002,002.0002

Express the following in figures:

10. Two million, six and four thousandths.

11. 45 in the third period, 4 in the second period, 101 in the first period, and 7 ten-thousandths.

12. The periods to the left of trillions are *quadrillions, quintillions, sextillions, septillions, octillions.*

Give sums:

1. 60 70	**2.** 40 80	**3.** 70 30	**4.** 80 50	**5.** 20 90
6. 38 80	**7.** 18 50	**8.** 47 40	**9.** 64 90	**10.** 75 80
11. 42 76	**12.** 28 95	**13.** 32 89	**14.** 56 74	**15.** 88 96
16. 146 9	**17.** 235 8	**18.** 476 5	**19.** 197 7	**20.** 579 5
21. 7 6 4 8 9 3	**22.** 8 12 7 14 6 8	**23.** 4 8 11 7 15 7	**24.** 9 11 7 13 4 16	**25.** 4 3 6 15 15 8
26. 300 260	**27.** 480 500	**28.** 770 600	**29.** 800 790	**30.** 362 700
31. 563 240	**32.** 389 470	**33.** 186 560	**34.** 890 366	**35.** 638 470
36. 7 6 8 5 9 8 8 6	**37.** 8 11 14 6 10 8 12 7	**38.** 7 13 10 10 5 12 5 3	**39.** 17 3 10 8 4 7 12 14	**40.** 6 14 7 10 6 14 10 8

It is taken for granted that you are familiar with all terms and definitions used in addition.

See how many of the following examples you can add in ten minutes. Check your result by adding in the reverse order.

Work for *rapidity* and *accuracy*.

Add:

1. 36.136	**2.** 81.0706	**3.** 8,074,512,096
175.026	79.7463	17,638,917,847
49.009	8.4976	986,908,174
273.165	76.0798	8,618,076,508
115.009	5.0075	72,811,487,766
7.198	47.9634	19,483,761,088
206.074	50.0091	79,486,718
8.150	61.9009	1,777,666,555
42.078	9.0974	87,078,809,607
502.309	18.7856	8,594,071,746

4. 85.207	**5.** 985.071	**6.** 4,786,652,925
9.756	76.536	36,889,753,642
175.563	7.756	700,700,743,658
87.085	317.875	7,665,478,938
5.050	83.578	605,350,784,376
576.816	3.009	91,645,888,067
37.702	81.076	4,676,059,276
4.568	469.854	650,395,000,806
69.071	54.078	74,083,006,789
248.706	7.705	5,809,675,342

7. Add \$205.71; \$1096; \$76.07; \$709.68.

8. Add \$1706.24; \$2603.19; \$19.27; \$90.70; \$2478.11; \$807.29; \$6.05.

It is understood that you are by this time familiar with the process of subtraction and can give a definition of each term used.

1. From 74 take 48. Train the pupil to *think* $74 - 8 = 66$, $66 - 40 = 26$, but to *say* 74 less 48 are 26.

Subtract the following orally and rapidly:

2. 17 9	3. 11 7	4. 16 9	5. 13 8	6. 12 7
7. 70 40	8. 90 50	9. 80 40	10. 80 70	11. 60 20
12. 32 10	13. 45 20	14. 94 30	15. 37 10	16. 86 50
17. 50 37	18. 87 48	19. 62 57	20. 53 36	21. 73 48
22. 62 19	23. 91 29	24. 47 18	25. 37 17	26. 56 48
27. 500 200	28. 260 100	29. 480 200	30. 735 300	31. 516 200
32. 300 180	33. 320 190	34. 410 270	35. 530 240	36. 170 90

37. In examples 2–7, name in each the subtrahend and minuend.

38. The minuend is \$1.00, the subtrahend 87¢. What is the difference?

39. The subtrahend is \$7.07, and the minuend is \$12.01. What is the difference?

Subtract and check each answer by adding the subtrahend and remainder. The sum should equal the minuend.

Try to do as many examples as possible in ten minutes.

Subtract:

1. 45.074 19.763	2. 81.005 27.107	3. 104.071 96.408	4. 400.004 278.198
5. 176.952 95.078	6. 298.375 147.498	7. 886.004 709.095	8. 720.019 370.086
9. 500.004 208.466	10. 701.014 370.706	11. 800.071 574.128	12. 600.006 281.079
13. 454,235 198,687	14. 311,110 126,378	15. 901,102 784,364	16. 410,011 173,208
17. 1,074,018 956,173	18. 7,072,343 2,708,196	19. 1,001,114 750,808	20. 1,011,013 970,806
21. 7,005,426 2,760,184	22. 4,088,256 2,176,408	23. 6,009,623 3,018,417	24. 5,101,005 2,078,163
25. 3,526,037 1,473,182	26. 6,918,329 2,075,143	27. 7,480,291 4,178,906	28. 8,076,931 5,138,472
29. 2,453,721 1,708,236	30. 2,836,807 1,745,268	31. 5,046,238 2,705,107	32. 8,097,390 5,148,625
33. 7,408,172 3,054,837	34. 7,000,003 5,684,108	35. 5,001,004 1,706,192	36. 2,040,104 1,096,426

It is taken for granted that you can define each term used in multiplication.

1. In the following point out the abstract numbers: 3 in.; \$8; 41; 4 bu.; 19; 3 pencils.

2. In example 1, point out the concrete numbers.

3. Can the multiplier ever be a concrete number?

4. When may the product be a concrete number?

Name multiplicand, multiplier, and product in each of the following:

5. \$12 × 7 = ——

6. 9 × 8 in. = ——

7. 9 pt. × 7 = ——

8. 6 × 12 qt. = ——

9. 5 boys × 9 = ——

10. 8 × 11 yr. = ——

Give products at sight:

11.	12 12	12.	15 3	13.	63 2	14.	81 7	15.	42 4
16.	50 4	17.	60 5	18.	70 6	19.	80 7	20.	90 8
21.	92 10	22.	74 10	23.	86 10	24.	67 10	25.	34 10
26.	54 100	27.	38 100	28.	56 100	29.	17 100	30.	68 100
31.	20 30	32.	30 50	33.	70 90	34.	80 60	35.	90 50
36.	82 1000	37.	49 1000	38.	57 1000	39.	38 1000	40.	76 1000
41.	30 900	42.	60 700	43.	70 800	44.	50 600	45.	80 900

You are expected to be familiar with the process of multiplication. See how many correct answers you can obtain in ten minutes. Accuracy and rapidity are essential to success.

Multiply:

1. 760,896 87	2. 781,438 65	3. 874,653 98	4. 876,543 67
5. 708,907 675	6. 875,809 793	7. 548,934 528	8. 479,738 975
9. 603,078 1,075	10. 509,096 4,807	11. 805,706 4,075	12. 670,908 5,806
13. 708,809 7,009	14. 209,703 8,006	15. 507,608 9,005	16. 707,606 7,008
17. 793,678 37,089	18. 607,787 95,204	19. 902,108 46,709	20. 567,819 78,965
21. 675,824 48,560	22. 246,105 78,700	23. 467,509 96,800	24. 610,708 40,700
25. 987,654 87,654	26. 213,456 67,843	27. 347,658 98,742	28. 645,806 75,693
29. 367,871 420,705	30. 785,694 508,709	31. 708,006 809,007	32. 700,098 860,005
33. 867,589 953,267	34. 751,689 778,856	35. 786,349 943,687	36. 985,764 865,429

1. Give two definitions for division.

2. Illustrate each definition by an example.

3. Define quotient, dividend, divisor, remainder.

4. When must the quotient be an abstract number, simply answering the question "*how many*"?

5. How do you prove an example in division?

6. The dividend is 24, and the divisor 6. Express this example in three ways.

7. The divisor is 4, and the quotient $5. What is the dividend?

8. The divisor is 7 marbles, and the quotient is 8. What is the dividend?

9. The divisor is 9 ft., and the dividend is 72 ft. What is the quotient?

10. The divisor is 6 and the dividend is 48 cents. What is the quotient?

In the following table use each number in the left-hand column as a divisor and the other numbers in the same line as dividends. Give quotients and remainders quickly.

7	30	80	17	50	25	60	37	48	64	73	90	81
12	15	27	100	40	110	53	124	65	135	78	145	90
5	8	37	12	41	18	47	24	53	29	57	33	63
9	17	25	33	41	49	58	66	74	82	95	101	113
6	31	64	11	38	69	16	45	75	21	51	26	56
8	10	50	84	17	61	75	28	90	67	37	100	47
10	51	86	13	98	49	105	22	113	65	37	126	74
4	19	31	43	7	25	10	34	13	37	47	22	51

See how many correct answers you can obtain in 15 minutes. Check your answer by multiplying the divisor by the quotient, and to the product adding the remainder if there is one. The result should equal the dividend.

Divide:

1. 65,146,158 by 2,541
2. 775,989,048 by 8,367
3. 298,678,520 by 6,284
4. 215,133,504 by 2,584
5. 595,009,536 by 8,192
6. 244,551,376 by 964
7. 411,296,028 by 858
8. 532,219,380 by 735
9. $11,591,635.44 by 1,397
10. $17,656,773.75 by 2,541
11. $16,482,231.09 by 3,107
12. $3,942,312 by 4,521
13. 1,934,074,813 by 6,259
14. 1,110,732,584 by 3,068
15. 328,122,663 by 2,409
16. 64,395,007 by 2,143

17. Divide two hundred forty-eight million, seven hundred seventy thousand, five hundred eighty-eight by four thousand seven.

18. Divide 283 million, 425 thousand, thirty by 8 thousand five.

19. Divide the sum of eighteen thousand, six hundred forty-two and thirty-seven thousand, two hundred fifty-four by one hundred thirty-six.

20. Divide three hundred seventeen thousand, eighty-two by eighty-six and multiply the quotient by one hundred nine.

21. Divide five hundred twenty-one thousand, seven hundred twenty by three hundred and multiply the quotient by one thousand seventy-six.

22. Multiply twenty-five thousand, three hundred sixty by three hundred eighty-four and divide the product by five hundred seventy-six.

23. A certain manufacturing company employs 996 men, each receiving the same pay. If the pay roll each week of 6 days amounts to $14,940, how much does each man receive a day?

1. At \$.85 a bushel what is the value of 29 loads of potatoes, each load containing 35 bushels?

2. A butcher bought 64 sheep at \$6.25 each, and others at \$6.50 each. If he paid \$679.50 for them all, how many sheep did he buy?

3. A merchant bought some oranges for \$1870, and sold them for \$2200, gaining 75 cents a box. Find the number of boxes and the cost of each.

4. A dealer gained \$518 on 74 tons of hay, which he sold at \$19.50 a ton. Find what the dealer paid a ton.

5. If 105 men can do a piece of work in 9 days, in how many days can 315 men do it?

6. The combined salary of A, B, C, D, and E is \$9600. A's salary is \$1400 and B's \$1600. If C, D, and E receive the same salary, how much does each receive?

7. If a man pays \$2160 for 24,000 pounds of copper, for how much a pound must he sell it to gain \$480?

8. A dealer paid \$13,500 for horses at \$75 each and sold them at \$98 each. If his expenses averaged \$5 a horse, how much did he gain?

9. Find the average price of 5 suits of clothes costing \$16.50, \$17.50, \$20, \$22.50, and \$27.50 respectively.

10. A merchant lost \$3475 on goods which he sold for \$15,725. How much would he have received for the goods if in selling them he had gained \$2275?

11. Two ships are 578 miles apart. If they move toward each other, one 12 miles an hour and the other 9 miles an hour, how far apart will they be at the end of 24 hours?

12. A certain city pays 110 men \$1375 for 5 days' work. What is the daily wages of each man?

13. A book agent bought 112 books at \$3.20 each and sold them at \$4.90 each. If his expenses were \$75 and he could not collect the money for 4 books, did he gain or lose and how much?

1. What two numbers multiplied together give 9 as their product? Of what two numbers is 21 the product?

2. Numbers that multiplied together make a given number are called its **factors.** A **factor,** then, is a number that *exactly divides* another number.

3. **Factoring** is the process of separating a number into its factors. What are the factors of 27? 15? 20?

4. A **prime number** is a number that has no factors except itself and one, as 2, 3, 5, 7, 11, etc.

5. A **composite number** is a number that contains other factors, as 4, 6, 12, 15, etc.

6. A number is exactly divisible (can be divided):
By 2, if the units' figure is 0 or is divisible by 2.
By 3, if the sum of the digits is divisible by 3.
By 5, if the units' figure is 0 or 5.
By 9, if the sum of the digits is divisible by 9.

Find the prime factors of 132.

$$\begin{array}{r|l} 2 & 132 \\ 2 & 66 \\ 3 & 33 \\ & 11 \end{array}$$

What prime number will divide 132? Dividing by 2, what is the quotient? What prime number will divide 66? Dividing again by 2, what is the quotient? What prime number will divide 33? Is the last quotient, 11, a prime number?

Test: $2 \times 2 \times 3 \times 11 = 132$. The prime factors of 132 are 2, 2, 3, 11.

Find the prime factors of:

7. 225	8. 891	9. 363	10. 1375
11. 567	12. 625	13. 288	14. 1728

15. Name some numbers that are divisible by 3. By 5.

16. Numbers that are divisible by other numbers are **multiples** of those numbers.

17. What is the smallest number that is divisible by both 3 and 5?

18. The least number that is divisible by each of several numbers is their **least common multiple.**

1. Find the least common multiple of 12 and 15.

A. $12 = 2 \times 2 \times 3$
$15 = 3 \times 5$
$2 \times 2 \times 3 \times 5 = 60$

We find that 2, 3, and 5 are the different factors. Since 2 is found twice in 12, it will be found twice in the least common multiple of 12 and 15.

B.
$2)\underline{12 - 15}$
$2)\underline{6 - 15}$
$3)\underline{3 - 15}$
$5)\underline{1 - 5}$
$1 - 1$

Arrange the numbers as indicated. Divide by any prime number that will divide one or more. When a number is not divisible, bring it down without change. Continue to divide till the quotients are unity. The product of all the divisors will be the least common multiple.

Find the least common multiple of:

2. 24, 32, 72 **3.** 9, 24, 36 **4.** 6, 15, 48
5. 9, 15, 27 **6.** 36, 16, 24 **7.** 8, 14, 56

Greatest Common Divisor

8. Name some numbers that will divide 12. That will divide 15.

9. A number that will exactly divide another number is a **divisor** of the number.

10. Name the *largest* number that will exactly divide both 12 and 15.

11. The largest number that will exactly divide two or more numbers is their **greatest common divisor.**

12. Find the greatest common divisor of 24, 36.

$2)\underline{24 - 36}$
$2)\underline{12 - 18}$
$3)\underline{6 - 9}$
$2 - 3$
$2 \times 2 \times 3 = 12$

Arrange the numbers as indicated. Divide by any prime factor that will divide both numbers. Divide the quotients by any factor that will divide both. Continue till there is no factor common to the quotients. The product of the divisors will be the greatest common divisor.

Find the greatest common divisor of:

13. 24, 36, 40 **14.** 15, 18, 27 **15.** 8, 16, 48
16. 32, 50, 64 **17.** 21, 48, 56 **18.** 18, 45, 90

Divide 30 by 15.

$30 = 2 \times 3 \times 5$

$15 = 3 \times 5$

$$\frac{30}{15} = \frac{2 \times \overset{1}{\cancel{3}} \times \overset{1}{\cancel{5}}}{\underset{1}{\cancel{3}} \times \underset{1}{\cancel{5}}} = 2$$

If we factor both numbers we find that 3 and 5 are factors of each number. Cross out or cancel the like factors in each number and 2 remains.

Cancelation is a method of shortening the work in division by rejecting equal factors. It is based on the principle that dividing both dividend and divisor by the same number does not change the quotient.

Divide 12×4 by 4×27.

$$\frac{\overset{4}{\cancel{12}} \times \cancel{4}}{\cancel{4} \times \overset{9}{\cancel{27}}} = \frac{4}{9}$$

The factor 4 is canceled from both dividend and divisor. The factor 3 is canceled from 12 in the dividend and from 27 in the divisor. The quotient is $\frac{4}{9}$.

Divide by cancelation:

1. 21×24 by 8×7
2. 42×35 by 49×20
3. 84×13 by 12×26
4. 48×20 by 36×10
5. $\dfrac{25 \times 12 \times 8}{10 \times 5 \times 11}$
6. $\dfrac{60 \times 48 \times 6}{30 \times 24 \times 12}$
7. $\dfrac{32 \times 14 \times 72 \times 50}{70 \times 64 \times 12 \times 15}$
8. $\dfrac{44 \times 8 \times 7}{11 \times 16 \times 7}$
9. $\dfrac{40 \times 18 \times 13 \times 8}{10 \times 13 \times 16 \times 2}$
10. $\dfrac{15 \times 4 \times 8 \times 9}{30 \times 2 \times 6 \times 12}$

11. What is the quotient of 88 times the product of 75 and 30, divided by 11 times the product of 25 and 24?

12. If 3 men can do a piece of work in 3 days, working 10 hours a day, how many days will it take 4 men, working 9 hours a day, to do the work?

13. A man worked for a farmer 8 weeks, 6 days a week, and received for his pay 16 sheep at \$6 a sheep. Find his wages a day.

It is taken for granted at this time that the pupils are familiar with fractions. If the teacher finds that this is not the case, she should teach the definitions and processes now. For this purpose a few lessons are given for review.

1. What is a fraction?

2. What are the terms of a fraction called?

3. What does the numerator of a fraction show?

4. What does the denominator of a fraction show?

5. In the fraction, $\frac{2}{3}$, we think of a unit as divided into how many parts? What must be true of those parts?

6. In this same fraction we think of how many parts as being taken to form the fraction?

7. Tell the meaning of $\frac{3}{4}$, $\frac{5}{6}$, $\frac{7}{8}$, $\frac{9}{10}$.

8. Which term of the fraction numbers the parts?

9. Which term of the fraction names the parts?

10. What is a mixed number? Give an illustration.

11. What is an improper fraction? Give an illustration.

12. $\frac{1}{2}$ is equal to how many fourths? Sixths ? Eighths?

13. Changing $\frac{1}{2}$ to $\frac{3}{6}$, $\frac{4}{8}$, etc., is called changing a number to *higher terms.*

14. Multiply both terms of the fraction, $\frac{1}{2}$, by 2. What is the result?

15. $\frac{2}{4}$ = how many halves? Changing $\frac{2}{4}$ to $\frac{1}{2}$ is called changing a number to *lower terms.*

16. How do you change fractions to lower terms?

17. When is a fraction in its lowest terms?

18. Is $\frac{15}{7}$ a proper or an improper fraction! Why?

19. Change $\frac{12}{16}$ to eighths. Did you change to higher or lower terms?

20. Change $\frac{2}{3}$ to 24ths. Did you change to higher or lower terms?

21. Changing the form of a fraction without changing its value is called **reduction.**

1. We have learned that we may multiply or divide both numerator and denominator of a fraction by the same number without changing its value.

2. Apply this principle in changing $\frac{3}{4}$ to 24ths. By what must you multiply both numerator and denominator to change the fourths to 24ths?

Reduce:

3. $\frac{5}{12}$ to 48ths **4.** $\frac{7}{9}$ to 108ths **5.** $\frac{2}{3}$ to 96ths

6. $\frac{5}{6}$ to 120ths **7.** $\frac{11}{16}$ to 128ths **8.** $\frac{17}{18}$ to 162ds

Reduce $\frac{64}{216}$ to its lowest terms.

A. $\frac{2)64}{2)216} = \frac{2)32}{2)108} = \frac{2)16}{2)54} = \frac{8}{27}$

B. 8 = greatest common divisor of 64, and 216.

$$\frac{8)64}{8)216} = \frac{8}{27}$$

Use either form of solution and reduce to their lowest terms.

9. $\frac{250}{375}$ **10.** $\frac{216}{432}$ **11.** $\frac{225}{675}$ **12.** $\frac{96}{480}$ **13.** $\frac{108}{540}$

14. $\frac{17}{204}$ **15.** $\frac{804}{2412}$ **16.** $\frac{2472}{4350}$ **17.** $\frac{1236}{1472}$ **18.** $\frac{3672}{8168}$

Reduce $4\frac{1}{3}$ to thirds.

$4 \times \frac{3}{3} = \frac{12}{3}$

$\frac{12}{3} + \frac{1}{3} = \frac{13}{3}$

Since $1 = \frac{3}{3}$, 4 must equal 4 times $\frac{3}{3}$ or $\frac{12}{3}$. $\frac{12}{3}$ and $\frac{1}{3} = \frac{13}{3}$.

Reduce to improper fractions:

19. $87\frac{2}{3}$ **20.** $167\frac{4}{5}$ **21.** $27\frac{3}{4}$ **22.** $83\frac{1}{3}$ **23.** $75\frac{2}{5}$

24. $79\frac{9}{16}$ **25.** $42\frac{13}{15}$ **26.** $87\frac{7}{12}$ **27.** $32\frac{13}{18}$ **28.** $38\frac{17}{24}$

Reduce $\frac{43}{6}$ to a mixed number.

$6)\overline{43}$

$7\frac{1}{6}$

Since $\frac{6}{6} = 1$ unit, there are as many units in $\frac{43}{6}$ as $\frac{6}{6}$ is contained times in $\frac{43}{6}$, that is $7\frac{1}{6}$. This is the same as dividing the numerator by the denominator, or performing the division expressed by the fraction.

Reduce to mixed numbers:

29. $\frac{476}{15}$ **30.** $\frac{271}{4}$ **31.** $\frac{84}{5}$ **32.** $\frac{381}{9}$ **33.** $\frac{465}{12}$

1. What kind of numbers can be added or subtracted?

2. Can you add 2 yd. and 24 in. without changing them? After changing each to feet can you add them?

3. What kind of fractions can be added or subtracted?

4. Can you add $\frac{1}{2}$ and $\frac{1}{3}$ without changing them?

5. $\frac{1}{2} = \frac{\ }{6}$ $\frac{1}{3} = \frac{\ }{6}$ $\frac{\ }{6} + \frac{\ }{6} = \frac{\ }{6}$

6. *Learn: Similar fractions are fractions having the same denominator. Fractions must be made similar before they can be added or subtracted.*

Find the sum of:

7. $\frac{3}{4}$ and $\frac{7}{8}$
8. $\frac{2}{3}$ and $\frac{5}{12}$
9. $\frac{4}{5}$ and $\frac{9}{10}$
10. $\frac{2}{3}$ and $\frac{5}{6}$
11. $\frac{3}{4}$ and $\frac{7}{12}$
12. $\frac{1}{3}$ and $\frac{7}{9}$

Find the difference between:

13. $\frac{3}{4}$ and $\frac{1}{2}$
14. $\frac{5}{6}$ and $\frac{5}{12}$
15. $\frac{2}{3}$ and $\frac{1}{6}$
16. $\frac{4}{5}$ and $\frac{3}{10}$
17. $\frac{5}{6}$ and $\frac{5}{9}$
18. $\frac{5}{7}$ and $\frac{3}{14}$

Add:

19. $4\frac{1}{2}$, 3, $5\frac{3}{4}$, $2\frac{1}{2}$
20. $3\frac{1}{3}$, $4\frac{1}{2}$, $5\frac{2}{3}$, $6\frac{1}{2}$
21. $5\frac{7}{8}$, 3, $6\frac{1}{4}$, $1\frac{1}{8}$
22. $2\frac{5}{6}$, $7\frac{1}{2}$, $2\frac{1}{4}$, $3\frac{1}{4}$

Subtract:

23. $7\frac{1}{2} - 2\frac{1}{4}$
24. $5\frac{3}{4} - 1\frac{1}{2}$
25. $8\frac{5}{6} - 3\frac{1}{3}$
26. $4\frac{7}{8} - 1\frac{1}{2}$

27. $5\frac{1}{3} - 2\frac{1}{2}$
28. $6\frac{2}{3} - 1\frac{5}{6}$
29. $8\frac{1}{4} - 2\frac{1}{2}$
30. $7\frac{3}{8} - 2\frac{3}{4}$

If the common denominator cannot be found by inspection, find the least common multiple of the denominators. (Lesson 14.)

1. Add: $8\frac{5}{6}$, $12\frac{7}{12}$, and $5\frac{2}{3}$

A.

	12
$8\frac{5}{6}$	10
$12\frac{7}{12}$	7
$5\frac{2}{3}$	8
25	$\frac{25}{12} = 2\frac{1}{12}$
$2\frac{1}{12}$	
$27\frac{1}{12}$	

B.

$$8\tfrac{5}{6} = 8\tfrac{10}{12}$$
$$12\tfrac{7}{12} = 12\tfrac{7}{12}$$
$$5\tfrac{2}{3} = 5\tfrac{8}{12}$$
$$25\tfrac{25}{12} = 27\tfrac{1}{12}$$

2. The sum of two numbers is $316\frac{7}{12}$. One of the numbers is $110\frac{3}{4}$. What is the other number?

3. A garden is in the form of a rectangle $112\frac{2}{3}$ ft. long and $79\frac{3}{4}$ ft. wide. What is the perimeter of the garden? How much does the length exceed the width?

4. A grocer sold $13\frac{1}{2}$ lb. of beef, $16\frac{3}{4}$ lb. of pork, and as many pounds of lamb as of the other two together. How many pounds did he sell in all?

5. A man's coal was delivered to him in three loads containing respectively $1\frac{1}{2}$ tons, $1\frac{3}{4}$ tons, and $1\frac{7}{8}$ tons. How many tons of coal were delivered to him?

Subtract:

6. $87\frac{5}{12} - 49\frac{5}{6}$ **7.** $41\frac{1}{3} - 17\frac{5}{6}$ **8.** $38\frac{1}{10} - 29\frac{1}{5}$

9. $71\frac{2}{5} - 27\frac{1}{4}$ **10.** $47\frac{3}{4} - 36\frac{1}{5}$ **11.** $73\frac{3}{8} - 56\frac{2}{3}$

12. $61\frac{1}{16} - 43\frac{3}{8}$ **13.** $53\frac{3}{5} - 27\frac{2}{3}$ **14.** $41\frac{3}{16} - 24\frac{1}{8}$

15. A merchant had $33\frac{1}{3}$ yd. of muslin. He sold $12\frac{1}{2}$ yd. to one woman, $9\frac{3}{4}$ yd. to another, and $7\frac{1}{8}$ yd. to another. How many yards did he have left?

16. $78\frac{5}{6} - 49\frac{3}{4} =$ **17.** $4\frac{1}{2} + 5\frac{2}{3} + 7\frac{5}{6} =$

18. A man having $\$45\frac{3}{4}$ received $\$24\frac{9}{10}$ for work, and then paid out $\$25\frac{1}{2}$. How much money had he left?

19. What number is $4\frac{1}{3}$ less than $7\frac{5}{9}$?

1. Multiply 12 by $\frac{2}{3}$.

$\frac{1}{3}$ of $12 = 4$
$\frac{2}{3} = 2 \times 4 = 8$

This means find $\frac{2}{3}$ of twelve. $\frac{1}{3}$ of $12 = 4$. $\frac{2}{3} = 2 \times 4 = 8$, or $12 \times \frac{2}{3} = \frac{2 4}{3} = 8$.

Learn: To multiply an integer by a fraction, multiply by the numerator and divide by the denominator.

Multiply:

2. 14 by $\frac{5}{7}$ **3.** $27 \times \frac{2}{3}$ **4.** $24 \times \frac{2}{9}$

5. 11 by $\frac{1}{2}$ **6.** $12 \times \frac{2}{5}$ **7.** $9 \times \frac{3}{4}$

8. Multiply $\frac{5}{6}$ by 2.

A. $\frac{5}{6} \times 2 = \frac{10}{6} = 1\frac{4}{6} = 1\frac{2}{3}$

B. $\frac{5}{\cancel{6}} \times \frac{\cancel{2}}{1} = \frac{5}{3} = 1\frac{2}{3}$

Use method *B* when the denominator exactly contains the integer.

Learn: To multiply a fraction by an integer, multiply the numerator by the integer or divide the denominator by the integer.

Multiply:

9. $\frac{7}{8}$ by 4 **10.** $\frac{9}{10}$ by 5 **11.** $\frac{5}{6}$ by 3 **12.** $\frac{2}{3}$ by 5

13. Multiply $\frac{1}{2}$ by $\frac{1}{3}$.

A. $\frac{1}{2} = \frac{3}{6}$, $\frac{1}{3}$ of $\frac{3}{6} = \frac{1}{6}$

B. $\frac{1}{2} \times \frac{1}{3} = \frac{1 \times 1}{2 \times 3} = \frac{1}{6}$

This means find $\frac{1}{3}$ of $\frac{1}{2}$. We may change $\frac{1}{2}$ to 3 sixths and then find $\frac{1}{3}$ of 3 sixths. But we see we obtain the same result by method *B*, hence the usual rule.

Learn: To multiply a fraction by a fraction, multiply the numerators together for the numerator, and the denominators together for the denominator. Use cancelation when possible to shorten the process.

Multiply:

14. $\frac{1}{2}$ by $\frac{4}{7}$ **15.** $\frac{2}{3}$ by $\frac{6}{8}$ **16.** $\frac{3}{4} \times \frac{5}{6}$ **17.** $\frac{2}{3}$ by $\frac{1}{6}$

1. Multiply $37\frac{5}{8}$ by 16.

$$\begin{array}{r} 37\frac{5}{8} \\ 16 \\ \hline 16 \times \frac{5}{8} = 10 \\ 16 \times 37 = 592 \\ \hline 16 \times 37\frac{5}{8} = 602 \end{array}$$

2. Multiply 61 by $9\frac{2}{5}$.

$$\begin{array}{r} 61 \\ 9\frac{2}{5} \\ \hline 5)122 \\ \hline \frac{2}{5} \times 61 = 24\frac{2}{5} \\ 9 \times 61 = 549 \\ \hline 9\frac{2}{5} \times 61 = 573\frac{2}{5} \end{array}$$

Multiply:

3. 75 by $8\frac{1}{3}$

4. 148 by $16\frac{2}{7}$

5. $66\frac{4}{5}$ by 18

6. 86 by $8\frac{4}{5}$

7. 235 by $36\frac{2}{3}$

8. $91\frac{7}{9}$ by 35

9. 63 by $7\frac{4}{7}$

10. 509 by $49\frac{4}{5}$

11. $56\frac{3}{7}$ by 28

12. Multiply $5\frac{2}{3}$ by $4\frac{3}{4}$.

$5\frac{2}{3} = \frac{17}{3}$. $\quad 4\frac{3}{4} = \frac{19}{4}$

$\frac{17}{3} \times \frac{19}{4} = \frac{323}{12} = 26\frac{11}{12}$

When both factors are mixed numbers they may be changed to improper fractions before multiplying.

Multiply:

13. $18\frac{5}{8}$ by $15\frac{5}{6}$

14. $42\frac{2}{3}$ by $21\frac{3}{5}$

15. $35\frac{3}{8}$ by $15\frac{3}{4}$

16. $75\frac{4}{7}$ by $36\frac{2}{3}$

17. $31\frac{2}{5}$ by $22\frac{2}{5}$

18. $71\frac{2}{3}$ by $51\frac{3}{4}$

19. $63\frac{4}{5}$ by $49\frac{5}{6}$

20. $52\frac{3}{4}$ by $21\frac{2}{7}$

21. $46\frac{3}{5}$ by $64\frac{2}{3}$

22. Find the cost of $27\frac{3}{8}$ cords of wood at $\$6\frac{1}{4}$ a cord.

23. What is the area of a rectangle $34\frac{5}{8}$ in. long and 21 in. wide?

24. A man sowed 48 acres of land with oats and $6\frac{7}{8}$ times as much with wheat. How many acres of wheat were there?

25. At the rate of $6\frac{7}{8}$ miles an hour, how far will a horse travel in $\frac{3}{4}$ of an hour?

26. At $\$\frac{7}{8}$ a yard, what will $7\frac{2}{3}$ yd. of silk cost?

1. Divide $\frac{3}{4}$ by 3.

A. $\frac{3}{4} \div 3 = \frac{3 \div 3}{4} = \frac{1}{4}$

B. $\frac{3}{4} \div 3 = \frac{3}{4 \times 3} = \frac{3}{12} = \frac{1}{4}$

A fraction may be divided by an integer by dividing the numerator by the integer or by multiplying the denominator by the integer. Use the first method whenever the numerator exactly contains the divisor.

Divide:

2. $\frac{5}{8}$ by 5
3. $\frac{6}{7}$ by 3
4. $\frac{3}{8}$ by 4
5. $\frac{6}{7}$ by 5
6. $\frac{4}{11}$ by 3
7. $\frac{5}{9}$ by 3
8. $\frac{3}{4}$ by 5
9. $\frac{9}{11}$ by 3

10. Divide 5 by $\frac{3}{4}$.

$5 = \frac{20}{4}$

$\frac{20}{4} \div \frac{3}{4} = 20 \div 3 = 6\frac{2}{3}$.

Change the integer to a fraction whose denominator is the same as that of the divisor, then divide the numerators.

Divide:

11. 4 by $\frac{2}{3}$
12. 5 by $\frac{3}{4}$
13. 8 by $\frac{5}{6}$
14. 6 by $\frac{3}{5}$
15. 9 by $\frac{1}{2}$
16. 7 by $\frac{2}{3}$
17. 5 by $\frac{2}{5}$
18. 3 by $\frac{4}{5}$

19. Divide $\frac{2}{3}$ by $\frac{3}{4}$.

$\frac{2}{3} = \frac{8}{12}$. $\frac{3}{4} = \frac{9}{12}$.

$\frac{8}{12} \div \frac{9}{12} = 8 \div 9 = \frac{8}{9}$.

Change both fractions to fractions having the same denominator, then divide the numerators.

Divide:

20. $\frac{7}{10}$ by $\frac{3}{5}$
21. $\frac{3}{12}$ by $\frac{3}{4}$
22. $\frac{5}{8}$ by $\frac{1}{4}$
23. $\frac{7}{10}$ by $\frac{1}{2}$
24. $\frac{5}{14}$ by $\frac{3}{7}$
25. $\frac{5}{8}$ by $\frac{3}{4}$
26. $\frac{5}{6}$ by $\frac{2}{3}$
27. $\frac{3}{4}$ by $\frac{5}{8}$
28. $\frac{3}{5}$ by $\frac{1}{4}$
29. $\frac{1}{2}$ by $\frac{3}{10}$
30. $2\frac{1}{3}$ by $\frac{1}{3}$
31. $4\frac{1}{4}$ by $\frac{1}{4}$

32. At $\$\frac{2}{5}$ each, how many caps can be bought for $\$2\frac{2}{5}$?

33. If a boy earns $\$\frac{3}{10}$ a day, how long will it take him to earn $\$2\frac{1}{2}$?

34. At $\$\frac{4}{5}$ a pound how many pounds of tea can I buy for $\$1\frac{3}{5}$?

Divide $5\frac{1}{2}$ by $\frac{3}{4}$.

A. $5\frac{1}{2} \div \frac{3}{4} = \frac{11}{2} \div \frac{3}{4} =$

$\frac{22}{4} \div \frac{3}{4} = 22 \div 3 = 7\frac{1}{3}$

A. Change both fractions to a common denominator and then divide the numerators.

B. $5\frac{1}{2} \div \frac{3}{4} = \frac{11}{2} \div \frac{3}{4} =$

$\frac{11}{\cancel{2}} \times \frac{\overset{2}{\cancel{4}}}{3} = \frac{22}{3} = 7\frac{1}{3}$

B. Since 1 divided by $\frac{3}{4}$ is $\frac{4}{3}$, $1\frac{1}{2} \div \frac{3}{4}$ is $1\frac{1}{2}$ of $\frac{4}{3}$, or $1\frac{1}{2} \times \frac{4}{3}$.
Canceling and multiplying, the result is $7\frac{1}{3}$.

Since a fraction is an expression of division, $\frac{3}{8} \div \frac{5}{7}$ may be written $\frac{\frac{3}{8}}{\frac{5}{7}}$. When written in this form it is called a complex fraction.

A **complex fraction** is one having a fraction for one or both of its terms.

A complex fraction is **simplified** by performing the operations indicated.

Simplify:

1. $\frac{12\frac{1}{2}}{37\frac{1}{2}}$ **2.** $\frac{2\frac{4}{5}}{1\frac{3}{4}}$ **3.** $\frac{1\frac{1}{5}}{2\frac{1}{3}}$ **4.** $\frac{33\frac{4}{9}}{7\frac{3}{4}}$

Simplify: $\frac{12\frac{1}{2} \times 11\frac{1}{5}}{68\frac{3}{4} + 1\frac{1}{4}}$

Solution: $12\frac{1}{2} \times 11\frac{1}{5} = \frac{25}{2} \times \frac{56}{5} = 140$
$68\frac{3}{4} + 1\frac{1}{4} = 70$
$\frac{140}{70} = 2.$

5. $\frac{\frac{3}{5} \times 6\frac{1}{4}}{\frac{2}{3} \times 7\frac{1}{2}}$ **6.** $\frac{27\frac{2}{3} \times \frac{4}{9}}{12 \div \frac{2}{3}}$ **7.** $\frac{\frac{2}{9}}{\frac{3}{4}} \times \frac{\frac{3}{4}}{\frac{5}{9}}$

8. If an express train moves at the rate of $40\frac{1}{4}$ miles an hour, how long will it take it to travel from A to B, a distance of $362\frac{1}{4}$ miles?

9. A cubic foot of ice weighs $57\frac{1}{2}$ pounds. How many cubic feet are there in a pile of ice that weighs $7515\frac{5}{8}$ pounds?

1. If 4 acres of land cost \$300, what will 7 acres cost?

Statement:

$$\frac{\$300}{4} \times \frac{7}{1} = \$525.$$

If 4 acres cost \$300, 1 acre will cost $\frac{1}{4}$ of \$300, and 7 acres will cost 7 times $\frac{1}{4}$ of \$300, or \$525.

2. If $\frac{4}{5}$ of an acre of land cost \$60, what will $\frac{7}{15}$ of an acre cost?

Statement:

$$\$60 \times \frac{5}{4} \times \frac{7}{15}.$$

If $\frac{4}{5}$ of an acre cost \$60, 1 acre will cost $\frac{5}{4}$ of \$60, and $\frac{7}{15}$ of an acre will cost $\frac{7}{15} \times \frac{5}{4} \times \$60$. Find answer by cancelation.

NOTE: — In this problem work, have the pupils make a statement of all processes to be used in the solution, and then shorten the work by cancelation. If this plan is followed, pupils must *think* before they begin to perform the necessary operations.

3. If $7\frac{1}{2}$ lb. of raisins cost \$.85, what will $4\frac{1}{2}$ lb. cost?

4. If 9 oranges cost $\$.22\frac{1}{2}$, what will 16 oranges cost?

5. What will $4\frac{1}{3}$ tons of coal cost, if $10\frac{4}{7}$ tons cost \$75.48?

6. How many gallons of molasses at $37\frac{1}{2}¢$ a gallon are worth as much as $12\frac{3}{4}$ bu. of potatoes at $40¢$ a bushel?

7. If $6\frac{7}{8}$ cd. of wood cost $\$38\frac{1}{2}$, what will $2\frac{1}{2}$ cd. cost?

8. What must I pay for $37\frac{2}{3}$ tons of coal, if $12\frac{1}{3}$ tons cost \$74?

9. If $13\frac{1}{3}$ lb. of sugar cost $80¢$, what will $8\frac{3}{4}$ lb. cost?

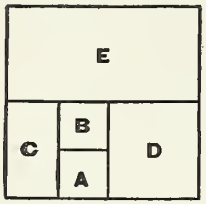
10. A man who owns a mine sold $\frac{3}{40}$ of it for \$3000. At the same rate, for what could he sell $\frac{1}{4}$ of the mine?

11. One box weighs $17\frac{1}{2}$ lb. A second box weighs 2 times as much as the first. A third box weighs $\frac{1}{5}$ as much as the second. Find the weight of the second box. Of the third box.

12. A man traveled $\frac{1}{4}$ of a certain distance by train, and $\frac{5}{8}$ by automobile. If he walked $\frac{1}{3}$ of the remaining distance, what part of the whole distance did he walk? If the whole distance was 180 miles, how many miles did he walk?

1. Add $20\frac{2}{3}$, $128\frac{3}{7}$, $4\frac{1}{2}\frac{1}{1}$, $81\frac{5}{9}$.
2. Add $71\frac{1}{3}$, $96\frac{7}{8}$, $17\frac{7}{16}$, $9\frac{3}{4}$, $44\frac{2}{2}\frac{3}{4}$.
3. Add $136\frac{3}{4}$, $7\frac{4}{7}$, $35\frac{5}{14}$, $71\frac{1}{2}$.
4. From $145\frac{2}{3}$ take $76\frac{1}{4}$.
5. Take $195\frac{5}{16}$ from $717\frac{3}{4}$.
6. Find the difference between $214\frac{3}{4}$ and $387\frac{3}{8}$.
7. Multiply $875\frac{3}{8}$ by 234.
8. Find the product of $645\frac{7}{8}$ and 412.
9. Multiply 215 by $41\frac{7}{8}$.
10. Multiply 575 by $69\frac{5}{6}$.
11. Find $\frac{2}{3}$ of $\frac{3}{4}$ of $\frac{5}{6}$ of $\frac{8}{9}$.
12. Change to a simple fraction $(\frac{5}{12} + \frac{3}{4}) \times (\frac{5}{14} - \frac{1}{7})$.
13. Multiply $136\frac{3}{4}$ by $41\frac{5}{8}$.
14. Find the product of $612\frac{1}{4}$ and $42\frac{5}{9}$.
15. Divide $6345\frac{3}{5}$ by 16.
16. What is the quotient of $583\frac{1}{3}$ divided by $43\frac{3}{4}$?
17. Simplify $\dfrac{18\frac{1}{2} \div 12\frac{1}{3}}{16\frac{1}{2} - 15\frac{5}{6}}$.
18. Simplify $\dfrac{\frac{1}{4} + 3\frac{1}{2}}{5\frac{2}{3} - 3\frac{1}{6}}$.
19. Simplify $\dfrac{\frac{7}{8}}{\frac{3}{4}} \times \dfrac{\frac{5}{9}}{\frac{1}{16}}$.
20. Divide $347\frac{5}{6}$ by 15. 692 by $19\frac{2}{9}$.
21. Divide $19\frac{4}{9}$ by $16\frac{2}{3}$. $786\frac{1}{2}$ by $30\frac{1}{4}$.
22. Add $2\frac{1}{15}$, $8\frac{1}{6}$, $27\frac{2}{3}$, $9\frac{1}{5}$.
23. Add $8\frac{3}{10}$, $37\frac{3}{4}$, $28\frac{4}{5}$, $9\frac{9}{20}$, $19\frac{1}{2}$.
24. From $27\frac{9}{40}$ take $18\frac{3}{5}$.
25. If $9\frac{1}{4}$ is taken from $12\frac{1}{6}$, what will remain?
26. Multiply $8\frac{3}{5}$ by 125. 15 by $16\frac{2}{3}$.
27. Divide $63\frac{1}{3}$ by $\frac{5}{6}$.
28. From $513\frac{7}{12}$ subtract $216\frac{1}{3}$.

Answer orally as many as possible.



1. E is what part of the whole square?
2. If the whole square is 4, what is the value of E?
3. 2 is what part of 4?
4. D is what part of the whole square?
5. If the whole square is called 8, what is the value of D?
6. 2 is what part of 8?
7. A is equal to what part of D? C is equal to what part of E?
8. *a.* 8 is what part of 64? *b.* $\frac{3}{5}$ is what part of $3\frac{3}{5}$?

a. $\frac{8}{64} = \frac{1}{8}$.

a. Since 1 is $\frac{1}{64}$ of 64, 8 is $\frac{8}{64}$ or $\frac{1}{8}$.

b. $\frac{\frac{3}{5}}{3\frac{3}{5}} = \frac{3}{5} \times \frac{5}{18} = \frac{1}{6}$

Learn: To find what part one number is of another, write the first number as the numerator of a fraction, the second number as its denominator, and reduce the fraction to its lowest terms.

9. What part of 150 is 120?
10. A peck is what part of a bushel?
11. A foot is what part of 144 inches?
12. There are 160 sq. rd. in an acre. What part of an acre is a rectangular piece of land 5 rd. long and 4 rd. wide?
13. There are 5280 ft. in a mile. An aeroplane rose 660 ft. into the air. What part of a mile was it from the ground?
14. An aeronaut drove his dirigible balloon at a height of 3000 ft. when crossing the Hudson River and at a height of 500 ft. when crossing New York City. What part of a mile was he from the ground at each height?
15. A man had $3150 on deposit in a bank. If he should withdraw $250, what part of his money would still remain in the bank?
16. What part of 144 is 72?

1. If $\frac{5}{6}$ of an acre of land is worth \$15, what are $10\frac{1}{2}$ acres worth?

2. If you earn $\$\frac{7}{8}$ in a day and your brother $\$\frac{3}{8}$ in a day, how much will you both earn in 8 days?

3. If 7 bbl. of apples cost \$21, what will 6 bbl. cost?

4. When milk is 5¢ a quart, what will 5 gal. cost?

5. In 96 oz. there are how many half-pounds?

6. If a grocer should put 320 oz. of cloves into quarter-pound packages, how many packages would he have?

7. How many quarts will it take to fill a bag holding $2\frac{1}{2}$ pk.?

8. What is the cost of 4 pk. 4 qt. of nuts at 20¢ a peck?

9. How many cubic feet of earth must be removed to dig a cellar 30 ft. long, 20 ft. wide, and 4 ft. deep?

10. How many square yards are there in 27 sq. ft.? In 54 sq. ft.? In 72 sq. ft.?

11. How many inches are there in $4\frac{1}{2}$ ft.?

12. How many inches are there in $2\frac{1}{3}$ yd.?

13. If $\frac{3}{7}$ of a man's weekly salary is \$9, how much does he earn each week?

14. If $2\frac{1}{4}$ bbl. of apples cost \$9, what will 1 bbl. cost? What will $8\frac{1}{4}$ bbl. cost?

15. Reduce to improper fractions: $6\frac{5}{6}$, $9\frac{3}{5}$, $7\frac{3}{7}$, $5\frac{3}{4}$, $4\frac{3}{8}$.

16. Mr. C sold a farm for \$1200, which was $\frac{6}{7}$ of its cost. Find the loss.

17. If a boy can do a piece of work in 30 min., how many hours will it take him to do 12 times as much work?

18. How much will 6 yd. of silk cost at $\$2\frac{1}{2}$ a yard?

19. Mr. Brown is 40 yr. old and his son is $\frac{2}{5}$ as old. How old is the son?

20. If $2\frac{3}{4}$ yd. of velvet are sold from a piece containing $3\frac{1}{2}$ yd., how many yards will be left?

21. If 12 is $\frac{1}{3}$ more than another number, how many thirds is it of that number? What is the number?

1. If 5 men mow 15 acres in 6 days, in how many days can 12 men mow the same number of acres?

2. Write in Roman numerals 1894, 1909.

3. At \$6.40 a ton, how much will 3675 lb. of coal cost?

4. The perimeter of a rectangle is 124 rd. and the width is 12 rd. Find the length. Find the area.

5. Find the area of a rectangle 150 ft. long and 4 rd. wide.

6. The total length of a railroad is 1818 miles. If the total cost was \$157,091,562, what was the average cost a mile?

7. What will it cost at 16¢ a yard to fence a field $28\frac{3}{4}$ rd. square?

8. The dividend is 300 and the divisor is 17. What is the remainder?

9. Find the least common multiple of 28, 30, 40, 56, 60.

10. A man owned $\frac{7}{8}$ of a ship and sold $\frac{3}{5}$ of his share for \$16,800. Find the value of the whole ship.

11. A fruit dealer paid \$14.95 for 5 bu. 3 pk. of peaches. If he sold them for 75¢ a peck, how much did he make?

12. How many times must a man walk the length of a field in plowing a strip 36 ft. wide, if the plow turns a furrow 9 in. wide each time?

13. If the field in example 12 is 80 rd. long, how many miles must the man walk?

14. Mr. Jones sold a span of horses for $\$396\frac{4}{5}$. If he lost $\$78\frac{1}{2}$, what did the span cost?

15. If Mr. Jones had gained $\$125\frac{9}{10}$, what would he have received for the span of horses?

16. Find the total cost of the following articles: 8 lb. tea at $62\frac{1}{2}$¢; 5 bags flour at 95¢; 90 lb. sugar at $5\frac{1}{2}$¢; 5 lb. 8 oz. of cheese at 14¢; 8 lb. of starch at $6\frac{1}{4}$¢.

17. If $7\frac{1}{2}$ tons of hay cost \$120, how many tons can be bought for \$78?

18. If $\frac{2}{7}$ of a yd. of cloth cost \$1.20, what will $4\frac{3}{7}$ yd. cost?

1. The area of an oblong is 24 sq. ft. What part of its area is that of a square whose side is 2 ft.?

2. Divide $2\frac{1}{3}$ by $2\frac{1}{4}$. Divide $4\frac{1}{2}$ by $2\frac{1}{4}$. Multiply together the two quotients.

3. A grain dealer had \$2013.42. He bought 370 bu. wheat at \$1.12; 980 bu. corn at 54¢; 536 bu. rye at 62¢; If he invested the rest of his money in flour at \$6.25 a barrel, how many barrels of flour did he buy?

4. A can finish a piece of work in 4 days, B in 6 days, and C in 8 days. What part can each do in a day? What part can all do in a day? In how many days can the work be finished if all work together?

5. The sum of two numbers is 947. If one of them is 249, what is the other?

6. The smaller of two numbers is 278. If their difference is 179, what is the greater number?

7. If $5\frac{4}{7}$ yd. of cloth cost \$1.17, how much must be paid for $43\frac{1}{3}$ yd.?

8. At \$.75 a square yard it cost \$99 to pave a walk. How many square yards are there in the walk? If the walk is 6 ft. wide, how long is it?

9. If a railroad charges $\frac{1}{2}$¢ a mile for the first 50 miles for carrying a barrel of flour, and then 4¢ for every 9 miles beyond the 50, what will it cost to carry 344 barrels 230 miles?

10. A man bought 27 head of cattle at \$32 each. If $\frac{1}{3}$ of them were killed, and the remainder were sold at \$53 each, find the gain or loss.

11. If a man owns $\frac{5}{9}$ of a farm and sells $\frac{2}{3}$ of his share for \$3460, what is the whole farm worth?

12. If an automobile runs $12\frac{1}{2}$ miles while a train runs $34\frac{1}{4}$ miles, how much farther will the train run in $6\frac{3}{4}$ hours?

13. If it takes $1\frac{7}{8}$ bu. of seed to sow $2\frac{1}{4}$ acres, how many bushels are needed to sow $17\frac{1}{4}$ acres?

1. Write one tenth as a common fraction. Write it as a decimal fraction.

2. Read 100.001, 5.00405, 25.0025.

3. Read the following as, *a*, mixed decimals, *b*, as hundredths: 5.05, 26.01, 4.08.

4. How many decimal places are needed to write millionths?

5. Name the decimal places in order from tenths to hundred-millionths.

6. Annexing a cipher to a decimal has what effect upon the value of the decimal?

7. Prefixing a cipher to a decimal has what effect upon the value of the decimal?

8. How should decimals be arranged for convenience in adding and subtracting?

9. How do you multiply a decimal by 10? By 100?

10. How do you divide a decimal by 10? By 100? By 1000?

11. Moving a decimal point four places to the right would multiply the decimal by what?

Multiply the following by 10 *and by* 100:

12. 4.5	13. 16.04	14. 201.01	15. 7.206
16. 18.2	17. 41.08	18. 116.01	19. 3.110
20. 11.5	21. 10.26	22. 508.96	23. 8.594

Divide the following by 10 *and* 100:

24. 6.01	25. 26.31	26. 704.06	27. 2.017
28. 10.26	29. 40.08	30. 210.71	31. 4.004
32. 16.74	33. 11.21	34. 307.08	35. 1.001

36. $\frac{1}{10}$ of \$60 = —— .2 of \$60 = ——.

37. Five hundredths of a dollar are how many cents?

38. \$2.15 = 2 ——, 1 ——, 5 ——.

39. Read 1.75 as a mixed decimal and as hundredths.

40. .316 − .2 = ——. .316 − .01 = ——.

1. Add 1.206, 26.01, 106.1, .00405, 5.04.

2. Find the difference between twenty-one millionths and six thousandths.

3. Multiply one and five hundred-thousandths by 36.

4. Divide nineteen and eight thousandths by twenty-seven.

5. In multiplying or dividing decimals by integers, where do you place the decimal point?

6. Multiply 30.03 by .24.

$$\left.\begin{array}{r} 30.03 \\ .24 \end{array}\right\} = \begin{array}{r} .3003 \\ 24 \end{array}$$

First move the decimal point in the multiplicand as many places to the left as there are decimal places in the multiplier, then multiply as by integers.

Multiply:

7. .0463 by 3.5
8. 402.0056 by 7.08
9. 4.308 by .416
10. 8624.05 by .036.

11. Divide 32.85 by 4.5.

$4.5\overline{)32.85} = 45\overline{)328.5}$

or $4.5\overline{)32.85}$

Before dividing change the divisor to an integer by moving the decimal points in both dividend and divisor to the right as many places as there are decimal figures in the divisor. Place the decimal point in the quotient directly above the point in the dividend.

Divide:

12. 57.3 by .004
13. 69.7 by .017
14. 2.516 by .156
15. 19.53 by 2.1

Specific gravity of any substance is found by dividing the weight of a cubic foot of that substance by 62.5 lb., the weight of a cubic foot of water.

The following gives the weight of a cubic foot of different substances. Find their specific gravity to the nearest thousandth:

16. Tin, 458.3 lb.
17. Steel, 490 lb.
18. Lead, 709.4 lb.
19. Gold, 1200.9 lb.
20. Copper, 552 lb.
21. Glass, 175.8 lb.

Do this work orally as far as possible.

1. Express the denominator of .5.

2. When .5 is written $\frac{5}{10}$, it is in the form of a common fraction.

3. How are decimal fractions changed to common fractions?

4. After expressing the denominator, what change should then be made in the fraction, as $\frac{5}{10} = \frac{\quad}{\quad}$.

Express as common fractions in their lowest terms:

5. .01	6. .0075	7. 17.15	8. 1.375
9. .0125	10. .005	11. 25.02	12. 5.875

13. You have learned that a fraction is an expression of division. After performing the division, to what form have you changed your common fraction?

Change the following to decimals, carrying the result to four decimal places when necessary:

14. $\frac{3}{8}$	15. $\frac{4}{9}$	16. $\frac{5}{11}$	17. $\frac{6}{9}$
18. $\frac{7}{8}$	19. $\frac{5}{6}$	20. $\frac{7}{12}$	21. $\frac{8}{15}$
22. $17\frac{2}{5}$	23. $49\frac{13}{20}$	24. $37\frac{25}{36}$	25. $21\frac{3}{4}$

Express the following common fractions as decimal fractions in hundredths:

26. $\frac{1}{2}$	27. $\frac{1}{4}$	28. $\frac{1}{3}$	29. $\frac{1}{5}$	30. $\frac{1}{6}$
31. $\frac{1}{8}$	32. $\frac{1}{10}$	33. $\frac{3}{4}$	34. $\frac{2}{3}$	35. $\frac{2}{5}$
36. $\frac{3}{5}$	37. $\frac{4}{5}$	38. $\frac{5}{6}$	39. $\frac{3}{8}$	40. $\frac{5}{8}$

41. Since *per cent* means *by hundredths*, express the common fractions above as per cents.

Express as per cents, that is, as hundredths:

42. $1\frac{3}{4}$	43. $2\frac{1}{2}$	44. $\frac{3}{20}$	45. $\frac{4}{25}$	46. $1\frac{7}{50}$
47. $\frac{14}{200}$	48. $\frac{15}{300}$	49. $\frac{20}{24}$	50. $\frac{19}{50}$	51. $\frac{7}{125}$

1. Add five and three hundred eighty-two ten-thousandths, one thousand two hundred thirty-five hundred-thousandths, eight hundred ninety-six and fifty-one thousand three hundred twenty-seven millionths.

2. Multiply .0915 by .0056 and write the product in words.

3. Divide .0002784 by .032.

4. Divide 1867.8 by 4000.

5. Find the cost of 825 bu. of grain at $\$1.66\frac{2}{3}$ a bushel.

6. Find the cost of 72 gal. of olive oil at $\$3.87\frac{1}{2}$ a gallon.

7. Add $17\frac{3}{8}$, $12\frac{1}{3}$, $.5\frac{4}{5}$, $12.48\frac{2}{3}$, $.4\frac{1}{3}$, $\frac{5}{8}$, $4\frac{2}{3}$, $16\frac{1}{8}$.

8. The product of two numbers is 13.02042, and one of the numbers is 6.414. What is the other number?

9. A cubic foot of brick weighs 118.3 lb. and a cubic foot of water weighs $62\frac{1}{2}$ lb. What is the specific gravity of brick, that is, the brick is how many times heavier than water?

10. Olive oil is .912 as heavy as water. Find the weight of a cubic foot of olive oil.

11. A bill board measures 20.5 ft. by 8.25 ft. Find the square feet of surface.

12. Suppose the wind is blowing against the bill board in example 11 with a pressure of 17.5 lb. to the square foot, find the total wind pressure against the board.

13. If the bill board was made strong enough to resist a pressure of 3000 lb., how many more pounds could it resist before falling?

14. Find to the nearest tenth the number of seconds it takes sunlight, traveling 186,650 mi. a second, to reach the earth. The sun is approximately 93,000,000 mi. from the earth.

15. A merchant bought 646 lb. of sugar for $38.76. In order to gain $9.69, for how much a pound must he sell it?

16. A man gave 180 acres to his son and had $\frac{2}{5}$ of his farm left. What is the value of the remainder at $\$39\frac{1}{2}$ an acre?

17. A can do a piece of work in 6 days, B in 8 days, and C in 12 days. In how many days can all do it together?

1. Find the cost of 4625 fence posts at $9 per C.

$$\left.\begin{array}{r}\$9\\ 46.25\end{array}\right\} = \begin{array}{r}46.25\\ \$9\\ \hline \$416.25\end{array}$$

4625 = 46.25 C.

If 100 posts cost $9, 46.25 C posts will cost 46.25 times $9, or $416.25.

In this example it is easier to use 9 as the multiplier; in explaining the work, however, be careful to use $9 as the multiplicand.

2. Find the cost of 46,250 ft. of lumber at $28.40 per M.

$$\begin{array}{r}\$28.40\\ 46.25\\ \hline\end{array}$$

46,250 = 46.25 or $46\frac{1}{4}$ M.

If 1000 ft. cost $28.40, $46\frac{1}{4}$ M will cost $46\frac{1}{4} \times \$28.40$.

3. Find the cost of 48,250 lb. of hay at $18 a ton.

A.
$$\begin{array}{r}48.25\\ \$9\\ \hline\end{array}$$

A. Since 2000 lb. cost $18, 1000 lb. will cost $9. If 1000 lb. cost $9, 48.25 M will cost 48.25 times $9.

B.
$$\begin{array}{r}\$18\\ 24\frac{1}{8}\\ \hline\end{array}$$

24.125 = $24\frac{1}{8}$ T.

B. 48,250 ÷ 2000 = $2\overline{)48.25}$

If 1 T costs $18, $24\frac{1}{8}$ T will cost $24\frac{1}{8}$ times $18.

4. Find the freight charges on a car-load of steel weighing 46,200 lb. at $2.25 per M.

5. On July 1, my gas meter registered 15,280 cu. ft., and on Oct. 1, 23,150 cu. ft. Find the cost of the gas consumed at 90¢ per M.

6. At $6.40 a ton, how much will 3675 lb. of coal cost?

7. What will 16,500 ft. of lumber cost at $22.75 per M?

8. Find the cost of 17,250 paving blocks at $8.65 per C.

9. Find the cost of 98,760 laths at $.35 per C.

10. What will 12,784 lb. of hay cost at $13.50 a ton?

11. Find the freight at 35¢ per C on 1500 lb. of hides, shipped from Chicago to Boston.

12. Find the total amount of freight paid on 4 car-loads of wheat, averaging 36,000 lb. each, shipped from Dakota to Minneapolis, the rate being 10¢ per C.

1. What does per cent mean?
2. Five per cent of anything is how many hundredths?
3. What is the sign of per cent?
4. Write 7 per cent, using the sign. Write it as a decimal.
5. What part of anything is 25% of it? 50% of it? $33\frac{1}{3}\%$? 75%? $87\frac{1}{2}\%$?
6. Find 25% of \$16, \$32, \$100, \$800, \$4.88.
7. Find 3% of 12.

Solution: 1% of 12 is .12. Then 3% must be $3 \times .12$, or .36.

8. Find 2% of 12, 15, 80, 25, 400, 900.
9. If 50% of a number is 80, what is the number?
10. If 7% of a number is 28, what is the number?

Solution: If 7% of a number is 28, 1% is $\frac{1}{7}$ of 28, which is 4. If 4 is 1%, 100% is 100 times 4, or 400.

11. If 8% of a number is 24, what is the number?
12. If 3% of a number is 36, what is the number?
13. If 6% of a number is 54, what is the number?
14. *a.* What part of 8 is 4? *b.* What per cent is it?

Solution: Since 1 is $\frac{1}{8}$ of 8, 4 must be $4 \times \frac{1}{8}$, or $\frac{4}{8} = \frac{1}{2}$, Ans. *a.* $\frac{1}{2}$ of 100% = 50%, Ans. *b.*

15. What part and what per cent of 9 is 3? Of 20 is 5? Of 30 is 6? Of 140 is 70?
16. What is 2% of 1200? Of 600? Of 80 ?
17. 20 is what per cent of 40? Of 60? Of 50? Of 100?
18. What is $12\frac{1}{2}\%$ of 480? $16\frac{2}{3}\%$ of 240?
19. What per cent of 48 is 6? Of 144 is 12?
20. 100% of anything is what part of that thing?
21. \$75 is what per cent of \$100?
22. Give the dimensions of a rectangle whose breadth is 25% of its length.
23. Find 75% of \$1200.

1. **Percentage** is the name of that part of arithmetic where all computing is done by hundredths.

2. Percentage is therefore an application of decimal fractions.

3. There are three problems in percentage:

   a. To find a certain percentage of a number.

   b. To find what per cent one number is of another.

   c. To find a number when a percentage is given.

a. Find 6% of $25.50.

$.255 = 1% of $25.50
6
$1.530

First find .01 by moving the point two places to the left, then multiply by the given per cent.

b. $210 is what per cent of $525?

$\frac{\$210}{\$525} = \frac{2}{5}$ or $\frac{2}{5}$ of 100% = 40%

.40
$525)$210.00
2100

Find what part one number is of the other, then change that fractional part to hundredths.

c. 346 is 40% of what number?

ANALYSIS.
40% = 346
1% = $\frac{1}{40}$ of 346 = 8.65
100% = 100 × 8.65 = 865

DECIMALLY.
.40)346 =
865
40)34600

Divide the given number by the rate per cent expressed decimally.

4. What is 17% of $872?

5. From a cut of cloth containing 81 yd., 27 yd. were sold. What per cent were sold? What per cent remained?

6. 534 is 75% of what number?

7. $750 is 62½% of my money. Find 75% of my money.

8. How much butter fat is there in 450 lb. of milk, if the creamery test shows that 36% of the total weight is fat?

9. An automobile was listed at $2500, but was sold at 15% below the listed price. At what price was it sold?

1. Find the gain per cent when the cost is \$600 and the selling price is \$618.

\$618
600
\$18 gain

.03
\$600)\$18.00

First find the gain. Then find what per cent the gain is of the cost. The cost is always considered 100%. See *b*, Lesson 36.

2. The selling price is \$175. Find the gain per cent, if the cost is \$150.

3. Find the cost when the selling price is \$73.84 and the loss is 80%.

100% cost
80% lost
20% selling price

20% = $\frac{1}{5}$
$\frac{1}{5}$ = \$73.84
$\frac{5}{5}$ = \$369.20

First find the selling per cent by subtracting the loss per cent from 100%. The example is then, \$73.84 is 20% of what number?

4. A man sold a horse for \$90 and lost $16\frac{2}{3}$%. What did the horse cost?

5. A lot of goods were sold for \$540, at a loss of 40%. Find the cost.

6. A man sold a horse for \$90 and gained 25%. What did the horse cost?

100% cost
25% gain
125% selling price

125% = \$90
a. 1.25)\$90
or
b. $\frac{5}{4}$ = \$90

First find the selling per cent by adding the gain per cent to 100%.

7. What per cent is gained when goods are bought for \$1236 and sold for \$1421.40?

8. What per cent is lost when goods are bought for \$144 and sold for \$128?

9. \$174.04 is 95% of how many dollars?

10. From a cask of rice containing 760 lb., 90 lb. were sold at one time, 60 lb. at another, and 40 lb. at another. What per cent was sold?

1. What part of 8 is 3? What per cent of it?

2. What is meant by $\frac{5}{6}$ of anything?

3. Nellie had 36 peaches. After eating 25% of them and giving away 50%, what per cent had she left? How many peaches had she left?

4. What 4 equal numbers make 20?

5. I paid 5¢ a pound for two packages of buckwheat, each package containing $2\frac{1}{2}$ lb. Find the cost.

6. Find the cost of $6\frac{1}{3}$ lb. of meat at 9¢ a pound.

7. Find the cost of $6\frac{1}{2}$ lb. of sugar at 6¢ a pound.

8. If \$18 is $\frac{1}{3}$ of my money, how much money have I?

9. Find the cost of $4\frac{1}{2}$ lb. of cheese at 16¢ a pound.

10. A man spent \$24 out of \$36. What per cent of his money had he left?

11. Find the cost of 7 chairs at \$3 each, 12 chairs at \$2 each, and a table at \$15.

12. What will $\frac{1}{3}$ of a ton of coal cost at \$6.30 a ton?

13. If you can buy 6 cards for a cent, how many can you buy for \$1?

14. How long is it from 15 min. before 7 o'clock in the morning to 15 min. after 6 o'clock in the evening?

15. By selling a horse for \$150, I gained $\frac{1}{4}$ of the cost. What did the horse cost?

16. Read the 15th example, using the equivalent per cent in place of the fraction.

17. If $\frac{2}{3}$ of a dozen oranges cost 16¢, how much will $2\frac{1}{4}$ doz. cost?

18. A man sold $\frac{1}{4}$ of his potato crop to one merchant, and $\frac{1}{4}$ to another, and had 100 bu. left. How many bushels had he at first?

19. If $3\frac{1}{8}$ lb. of meat cost 50¢, how much will 1 lb. cost? How much will $2\frac{1}{2}$ lb. cost?

20. What must I pay for $9\frac{1}{2}$ bbl. of apples, if $1\frac{1}{2}$ bbl. cost \$6?

1. Multiply seventy-three hundred-thousandths by one thousand.

2. Multiply 35 thousandths by 56 ten-thousandths and divide the product by 7 hundred-thousandths.

3. Divide five thousand fifty and five tenths by five hundredths and subtract twenty-five hundredths from the quotient.

4. Add $\frac{2}{3}$, $\frac{10}{14}$, $\frac{8}{12}$, $\frac{3}{7}$, and $\frac{30}{35}$. *First reduce to lowest terms.*

5. Divide 73.8 by .0008. $1\frac{4}{5}$ by $\frac{7}{5}$.

6. If 45 sheep cost \$540, what number will \$228 purchase?

7. If 12 cd. of wood cost \$54, what will $19\frac{5}{6}$ cd. cost?

8. How much commission (money paid for service) shall I pay an auctioneer for selling my house for \$5600 at $2\frac{1}{2}\%$?

9. Multiply 47,200 by 3400.

10. Add fifteen thousandths, eighty-one ten-thousandths, fifty-six millionths, seventeen ten-millionths, two hundred five hundred-thousandths.

11. Change to decimals and add, $1\frac{1}{2}$, $4\frac{3}{4}$, $5\frac{1}{8}$, $2\frac{3}{5}$, $1\frac{1}{125}$.

12. Multiply .032 by .005 and then divide .0512 by your product.

13. Take 27 and 28 thousandths from 97 and 7 tenths.

14. *Add vertically and horizontally:*

	a.	*b.*	*c.*	*d.*	*e.*	*f.*	
g.	\$4.76 +	\$3.87 +	\$5.64 +	\$7.12 +	\$6.05 +	\$8.17	= ——
h.	3.41 +	8.37 +	9.12 +	1.97 +	5.56 +	7.62	= ——
i.	9.26 +	5.65 +	6.85 +	3.58 +	4.19 +	4.74	= ——
j.	7.68 +	4.98 +	9.57 +	4.89 +	3.68 +	9.15	= ——
k.	4.45 +	2.76 +	2.44 +	6.15 +	7.77 +	1.48	= ——
l.	1.07 +	5.72 +	5.36 +	7.34 +	9.75 +	3.49	= ——

15. The population of Connecticut for 1900 was 908,420, and its area is 4990 square miles. There are 640 acres in a square mile. How many acres are there in Connecticut? How many acres might be allowed to each person in Connecticut?

Springfield, Aug. 1, 1910.

GEORGE GROCER,

Bought of JOHN FARMER.

July	26	15 bu. potatoes, at 75¢ 175 lb. butter, at 23¢ 115 doz. eggs, at 28¢ ½ ton hay, at $16	$	$

Received payment,

JOHN FARMER.

1. In the above bill who bought the goods?

2. The **buyer** is the **debtor** (Dr.).

3. Who sold the goods? The person of whom the goods are bought is the **creditor** (Cr.).

4. Read the first item of the account. This item gives the *quantity* of the article purchased and its *price.*

5. Rule paper in the form of a bill. Find the *cost* of the first item and place in the first column for dollars and cents.

6. State the quantity and price of each of the other items, and place cost in its place.

7. Find the *total amount* of the bill. This is sometimes called the *footing.* Place this amount in the second column for dollars and cents.

8. Notice carefully where every part of each item is placed.

9. What tells us that this bill has been paid?

10. The word "Paid" is sometimes used in place of "Received payment." Who signs the receipted bill, the debtor or the creditor?

11. Tell how a bill is receipted.

12. Name the debtor and creditor in this bill.

13. If you were clerk for John Farmer, how could you receipt the bill for him?

All business firms have paper ruled in the form of a bill, called *bill heads*. Write the following on bill heads or on paper that you rule in correct form:

1. John Farmer bought of George Grocer, July 26, 10 lb. coffee at 31½¢; 18 lb. starch at $.04; 1 box soap, $3.75; 48 lb. sugar at 6¢; 9 lb. tea at 65¢; 1 bbl. flour, $6.50.

2. After writing the above in the form of a bill, compare the footing with that of the bill in Lesson 40. What is the balance? In whose favor is it?

3. Jos. Burke bought of Benjamin Robb & Co., Jan. 21, 18 lb. tea at $.85; 24 lb. coffee at 32½¢. Feb. 5, 15 lb. rice at 8¢; 2 boxes raisins at $1.20. Feb. 10, he paid $22. Make out his bill March 1.

4. The following is the receipt that was given to Jos. Burke, Feb. 10.

$22 _____ _____ Feb. 10, ____

Received of Jos. Burke, twenty-two dollars to apply on his account.

BENJAMIN ROBB & CO.

5. When the full amount of a bill is paid, the same form of receipt is given, except that "in full of account to date" is written in place of "to apply on his account."

6. Write a receipt in full for Mr. Burke, dated March 10.

7. Sept. 1, John D. King bought of H. C. Hamilton, 900 ft. flooring, at $23.50 per M; 750 ft. studding, at $18 per M; 2000 shingles, at $4.25 per M.

8. May 15, John Gilman bought of R. H. White, 20 yd. silk, at $1; 64 yd. sheeting, at 7¢; 25 doz. hose, at $1.20. May 25, $25 was paid on account. June 1, the account was paid in full. Write the receipt on account May 25. Write the receipt in full June 1. Make out the bill.

For ruling of paper for cash account see Lesson 80, Book V.

1. In all accounts there are two sides called "Cash Received," and "Cash Paid." Finding the difference between the two amounts is called "**Balancing the account.**"

Make out and balance the following:

2. June 1, George had on hand \$2.75. Every day in the week he earned 20¢ from his paper route, and each week he earned 35¢ mowing a lawn. He spent 10¢ every day for carfare. June 15 he bought a cap for 50¢, and shoes for \$2.50. Balance George's account on June 30.

3. Sept. 1, Mr. R. had on hand \$10, and paid for meat 20¢, coffee, 35¢, peaches, 20¢. Sept. 2, he paid for laundry 32¢. for bread 10¢, for potatoes 18¢. Sept. 3, he received \$7.50 and paid for cheese 15¢, for tomatoes 15¢, for milk 42¢.

4. A grocer's receipts and expenditures for the several days of a week were respectively as follows: Monday, \$36.25 and \$19.17; Tuesday, \$42.18 and \$10.81; Wednesday, \$10.60 and \$15.14; Thursday, \$65.20 and \$5.13; Friday, \$34.11 and \$14.08; Saturday, \$90.15 and \$45.15.

5. The following is a weekly account of the hours of labor such as is usually kept in all manufacturing establishments:

Name	M.	T.	W.	T.	F.	S.	Hours	Wages per day	Money due
Adams..	8	7½	8½	8	9	8		\$1.75	
Brown..	7	8½	6	9	7	8½		\$2.25	
Cowles..	8	0	6	6	8	9		\$1.50	
Dwight .	7	4	0	8	7½	8½		\$2.75	
Total									

Counting 8 hr. to a day, enter the hours of labor and money earned in the proper columns. Find total paid out by firm.

1. When 9 hours is a day's work and \$1.50 is a day's pay, find each man's pay for the week, and the total sum paid out:

	M.	T.	W.	T.	F.	S.	Hours	Days	Money due
A.....	9	$8\frac{1}{2}$	$9\frac{1}{2}$	$7\frac{1}{2}$	8	$6\frac{1}{2}$			
B.....	8	10	7	$6\frac{1}{2}$	8	$8\frac{1}{2}$			
C.....	$6\frac{1}{2}$	$8\frac{1}{2}$	9	8	5	7			
D.....	$6\frac{1}{4}$	$5\frac{1}{2}$	9	$7\frac{1}{4}$	6	5			
E.....	8	9	7	8	9	8			
Total									

2. Supplying names and date, make out the following bill and receipt it:

$6\frac{1}{2}$ yd. lace at 36¢; 5 yd. flannel at 30¢; 8 yd. sheeting at $16\frac{1}{2}$¢; 10 yd. ribbon at 6¢; 12 yd. lawn at 15¢; 4 doz. buttons at 8¢; 6 handkerchiefs at 25¢.

3. Two trains are 150 miles apart and are traveling toward each other. One moves at the rate of $36\frac{1}{2}$ miles an hour and the other at the rate of $28\frac{3}{4}$ miles an hour. At the end of two hours how far apart are they?

4. A real estate dealer buys a lot for \$2300 and sells it at a gain of $18\frac{1}{2}\%$. How much does he gain? How much does he receive for the lot?

5. If 8.7% of the weight of a certain ore is copper, how many pounds of copper are there in 4260 lb. of ore?

6. If $17\frac{1}{2}$ lb. of tea cost \$12.60, what will $20\frac{3}{4}$ lb. cost?

7. A regiment went into battle with 960 men, and came out with 600 men. How many men were lost? What part were lost? What per cent were lost?

8. Divide .08 by .0016. 670.18 by .016.

9. My meat bill for the past two weeks was as follows: 4 lb. steak at 26¢; 2 lb. 9 oz. lamb chops at 16¢; 1 lb. 4 oz. sausages at 20¢; 4 lb. 8 oz. beef at 18¢; $8\frac{1}{4}$ lb. turkey at 22¢. Write this in the form of a bill and find the amount.

1. Find the area of a rectangle $8\frac{1}{2}$ ft. long and 6 ft. wide. What is the unit of measurement in this example?

$8\frac{1}{2}$ = sq. ft. in 1 row
6
51 sq. ft.

Multiply the number of square feet in one row by the number of rows.

2. How many cubic inches are there in a box 6 in. long, 4 in. wide, and 2 in. deep? What is the unit of measurement in this example?

6 = cu. in. in 1 row.
4
24 = cu. in. in 1 layer.
2
48 = cu. in. in box.

Multiply the number of cubic inches in one row by the number of rows to find the number of cubic inches in one layer. Then multiply the number of cubic inches in one layer by the number of layers.

3. A rectangle contains 72 sq. in. If it is 9 in. long, how wide is it?

72 sq. in. ÷ 9 sq. in. = 8
Hence 8 in. wide.

Divide the number of square inches in the rectangle by the number of square inches in one row to find the number of rows.

4. A garden is 10 rd. square. How many rods of fence will enclose it and divide it into 4 equal squares?

5. A rectangle 40 in. long contains 480 sq. in. How wide is it?

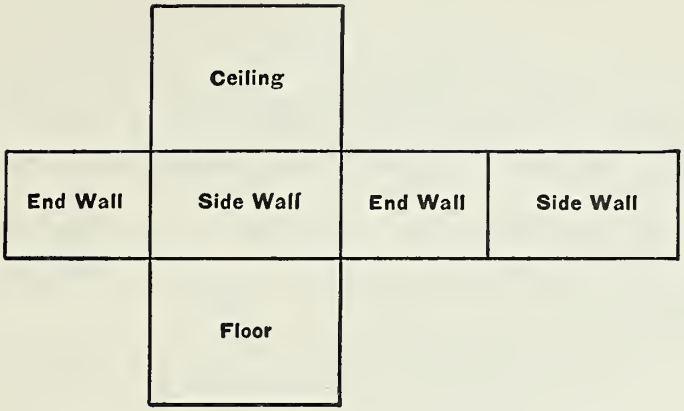
6. If you cut off a strip 1 in. wide all round a square foot of paper, how many square inches will you cut off?

7. At $2 a rod what will it cost to build a fence around a rectangle 20 rd. by 10 rd.?

8. How many 4-in. squares can you cut from a rectangle 12 in. by 8 in.?

9. How many cubic inches are there in a block of wood 3 ft. long and 10 in. square at the ends?

10. What two forms can you make, using 4 rectangles 1 ft. long and 3 in. wide?



1. This diagram represents the walls, ceiling, and floor of a room 16 ft. long, 12 ft. wide, and 9 ft. high. Scale $\frac{1}{16}$ in. to a foot. The walls form one rectangle. Find its dimensions. Its area. Give the dimensions of the ceiling. Its area.

NOTE: — Have the class in manual training make a model of a room so hinged that it will open like the diagram.

2. Find the number of square feet in the walls and ceiling of a room 14 ft. long, 12 ft. wide, and 8 ft. high.

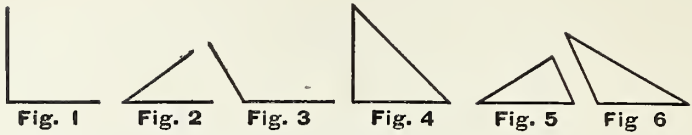
$2 \times (14 \text{ ft.} + 12 \text{ ft.}) = 52 \text{ ft.}$ perimeter.
$52 \text{ sq. ft.} \times 8 = 416 \text{ sq. ft.}$ in walls.
$14 \text{ sq. ft.} \times 12 = 168 \text{ sq. ft.}$ in ceiling.
$416 \text{ sq. ft.} + 168 \text{ sq. ft.} = 584 \text{ sq. ft.}$

Make a drawing to represent this room. Think of it as two rectangles. Give the length and width of each.

3. The perimeter of a room is 56 ft. 8 in. and its height 8 ft. 9 in. Find the area of the four walls.

4. A rectangular block of marble is 7 ft. long, 4 ft. wide, and $3\frac{1}{2}$ ft. high. Find the number of square feet in the surface of this block. Find the cost of the block at 60¢ a cubic foot.

5. A rectangular cistern is 8 ft. long, 6 ft. 6 in. wide, and $4\frac{1}{4}$ ft. deep. Find the number of square feet in the sides and bottom. Find the cost of lining it with sheet lead, weighing 9 lb. to a square foot, at 5¢ a pound.



The clock dial used in Grade II for teaching time should be in the room at this time.

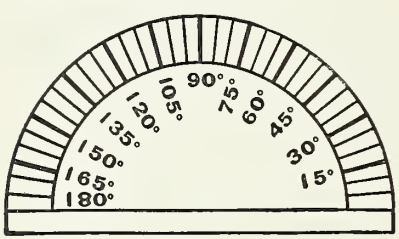
1. Take the clock dial. Place both hands at XII. Move the minute hand round to XII again. For convenience in measuring we say the whole circle is measured by **360 degrees**, or **360°**.

2. Move the minute hand to III. Over what part of the dial have you moved the hand? $\frac{1}{4}$ of 360° = 90°. We say the hands form an angle of 90° or a **right angle** (Fig. 1).

3. When two straight lines meet they are said to form an **angle**.

4. An angle that is less than a right angle is called an **acute angle** (Fig. 2). Move the hands on the clock dial to represent an acute angle.

5. An angle that is greater than a right angle is called an **obtuse angle** (Fig. 3). Change the hands on the clock dial to represent an obtuse angle.

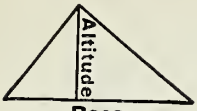


6. Cut from cardboard a figure like this and mark it in the same way. This is a **protractor** sufficiently accurate for all practical purposes.

7. Using the protractor, measure the angles in Fig. 4, Fig. 5, Fig. 6.

8. In the wheel of my carriage there are 12 spokes. How many degrees are there between 2 spokes?

9. When the hour hand of the clock is at 12, where must the minute hand be that the two hands may be 30° apart?



1. A plane figure bounded by three straight lines is a **triangle.**

2. The **base** is the side upon which it rests. The **altitude** is its height measured on a line that is perpendicular to the base. One line is *perpendicular* to another when they form an angle of 90°.

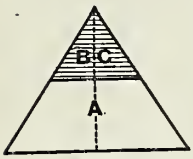


Fig. 1

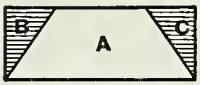


Fig. 2

3. Compare the base of Fig. 1 with that of Fig. 2. Compare their altitudes. How do you find the area of Fig. 2? Can you see from the drawings that both figures have the same area?

4. A triangle can be changed to a rectangle having the same base and $\frac{1}{2}$ the altitude, or having the same altitude and $\frac{1}{2}$ the base.



Fig. 3

5. From Fig. 3 we see that the area of a triangle is equal to $\frac{1}{2}$ that of a rectangle having the same dimensions.

6. The area of a triangle equals:

a. The product of the base and $\frac{1}{2}$ the altitude.

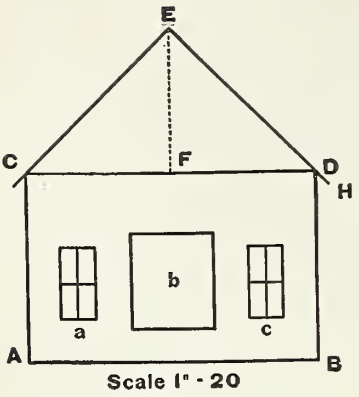
b. The product of the altitude and $\frac{1}{2}$ the base.

c. One half the product of the base and altitude.

NOTE: — The above rules are generally given because of their brevity. Lead the pupils to see that when both dimensions are given in inches we cannot multiply *inches* by *inches* and have *square inches* as the product. We really multiply the *number of square inches* in one row by the *number* of rows.

Find the area of triangles having the following dimensions:

	Base.	Altitude.		Base.	Altitude.
7.	12 in.	10 in.	**8.**	20 in.	8 in.
9.	15 ft.	16 ft.	**10.**	17 ft.	9 ft.
11.	$40\frac{1}{2}$ rd.	10 rd.	**12.**	$25\frac{1}{2}$ yd.	$12\frac{1}{4}$ yd.

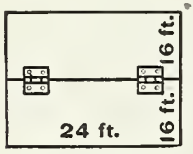


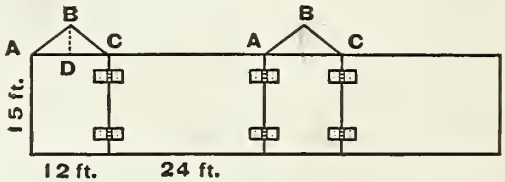
1. This drawing represents the end of a house. AB represents the width; AC the height to the eaves; EH the length of the rafters; the triangle CED is the *gable;* EF is the altitude of the gable; *a* and *c* are windows; *b* is a door. Using the scale, find each dimension.

2. To find the area of this end of the house you must find the area of one ——, and one ——.

3. Find the area without deducting doors and windows.

4. This drawing represents the roof and walls of a house. It was drawn from the model of a house made by a boy in the manual training room. To find the entire area, you find the area of —— rectangles and —— triangles.



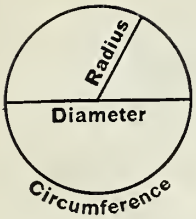


5. If BD is 3 ft., find the area of the 2 gables.

6. State the dimensions of the rectangle representing the roof. Find its area.

7. State the dimensions of the rectangle representing the 4 walls. Find the area of the 4 walls.

8. Make a drawing to represent the ends, sides, and roof of a house 42 ft. long, 36 ft. wide, and 18 ft. high from ground to eaves. The altitude of the gable is 12 ft. and the rafter is 22 ft. long. Find the number of square feet of lumber needed to board and roof the house.



1. This figure shows the circumference, diameter, and radius of a circle.

2. The line that bounds the circle is the **circumference.**

3. The line that passes through the center, cutting the circumference, is the **diameter.**

4. The distance from the center to the circumference is the **radius.** The radius is — — of the diameter.

5. Carefully measure the circumference and the diameter of a circle. The circumference is how many times the diameter?

6. Carefully compare the circumference and the diameter of several circles. Do you obtain the same result in each case?

7. It should be nearly $3\frac{1}{7}$. It is more nearly correct to say it is 3.1416. This ratio is usually expressed by the Greek letter π (pi).

8. *Learn:* *a.* π *times diameter equals circumference.*
b. 2 π *times radius equals circumference.*
c. Circumference divided by π *equals diameter.*
d. Diameter divided by 2 *equals radius.*

Using $\pi = 3\frac{1}{7}$, *find the circumference of a circle whose diameter is:*

9. 105 ft.	**10.** 126 in.	**11.** 98 yd.	**12.** 63 rd.
13. 112 ft.	**14.** 119 yd.	**15.** 84 in.	**16.** 56 in.

When $\pi = 3\frac{1}{7}$, *find the diameter of a circle whose circumference is:*

17. 22 ft.	**18.** 66 ft.	**19.** 88 in.	**20.** 264 in.
21. 132 in.	**22.** 154 ft.	**23.** 110 ft.	**24.** 242 yd.

Using $\pi = 3.1416$, *find the circumference or diameter of:*

25. A wheel whose diameter is 24.017 in.

26. A bottle whose diameter is 1.56 in.

27. A globe whose circumference is 45.075 in.

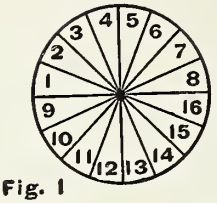


Fig. 1

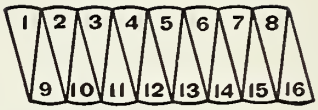


Fig. 2

1. Cut out of stiff paper a circle whose diameter is about 6 in. Cut it into 16 equal parts as is shown in Fig. 1.

2. Arrange the parts as shown in Fig. 2. Is the area of Fig. 2 the same as that of Fig. 1?

3. Into what shape, approximately, have you changed the circle?

4. The length of the rectangle (Fig. 2) is equal to what part of the circumference of the circle (Fig. 1)?

5. The width of the rectangle is the —— of the circle.

6. How do you find the area of the rectangle (Fig. 2)?

7. If Figs. 1 and 2 have the same area, have you found the area of the circle?

Learn: The area of a circle equals the product of $\frac{1}{2}$ *the circumference multiplied by the radius.*

8. What two dimensions of the circle do you need to know in order to find the area?

9. When one dimension is given can you find the other? How?

Find the area of a circle whose :

10. Diameter is 14 ft.
11. Circumference is 22 ft.
12. Radius is 14 ft.
13. Diameter is 21 ft.
14. Circumference is 66 ft.
15. Radius is 4.2 ft.

16. The wind is blowing directly against a circular window whose diameter is 6.3 ft. with a pressure of 18.5 lb. to the square foot. What total wind pressure must the window resist?

1. All kinds of lumber are measured by board feet.

2. A **board foot** is equivalent to a square piece of board 1 ft. long, 1 ft. wide, and 1 in. thick.

3. Boards less than 1 in. in thickness are reckoned as one inch thick, and when no thickness is mentioned one inch is understood.

4. In giving dimensions of lumber, ′ is usually used to designate feet and ″ to designate inches. Thus the dimensions of a board 12 ft. long, 10 in. wide, and 1 in. thick would be written $12' \times 10'' \times 1''$.

5. How many feet of lumber are there in 24 boards, each $12' \times 10'' \times 1''$?

$24 \times 12 \times \frac{5}{6} = 240$ feet.
Use cancelation.

When boards are 1 in. thick the number of board feet corresponds with the square feet of surface. Hence the rule, multiply the number of feet in length by the number of feet in width to find the board feet in one board.

6. How many feet of lumber are there in 10 planks, each $9' \times 8'' \times 2''$?

$10 \times 9 \times \frac{2}{3} \times 2 =$ ——.

Since a plank 2 in. thick could be cut into 2 boards each 1 in. thick, we multiply the number of feet in one board by the number of inches in thickness.

ORAL EXERCISES

Find the number of feet in boards of the following dimensions:

7. $16' \times 12''$	8. $16' \times 9''$	9. $14' \times 6'' \times 2''$
10. $12' \times 6''$	11. $12' \times 8''$	12. $16' \times 6'' \times 3''$
13. $20' \times 9''$	14. $12' \times 3''$	15. $8' \times 3'' \times 3''$
16. $14' \times 18''$	17. $15' \times 8''$	18. $14' \times 12'' \times 2''$
19. $16' \times 9''$	20. $18' \times 18''$	21. $10' \times 9'' \times 2''$
22. $12' \times 4''$	23. $20' \times 6''$	24. $24' \times 8'' \times 2''$

25. A beam is 24 ft. long, 10 in. wide, and 8 in. thick. How many board feet are there in it?

According to their size and use pieces of lumber are called by various names, as boards, planks, scantlings, joists, plates, sills, girders, beams, posts, etc.

Copy the following and fill in the squares the number of board feet in a piece of lumber of the length and size indicated. The numbers at the top give the length in feet, the numbers at the left the thickness and width:

	Size	12	14	16	18	20	22	24	26
1	2×4								
2	2×8								
3	3×4								
4	3×6								
5	3×12								
6	4×8								
7	6×8								
8	8×12								
9	10×12								

10. At \$16 per M find the cost of 42 boards, each $16' \times 6''$.

11. At \$28 per M find the cost of 750 planks, each $14' \times 12'' \times 2''$.

12. At \$18 per M, what will be the cost of boards to build a fence 4 boards high round a field 160 yd. long, 120 yd. wide, if each board is 6 in. wide?

13. Find the number of feet of lumber required to floor a barn 36 ft. long, 17 ft. 6 in. wide, if the planks are 18 ft. long, 12 in. wide, and $2\frac{1}{2}$ in. thick.

14. How many feet of boards will be needed to cover both gables of a building 27 ft. wide, if the height of the gable is 9 ft.?

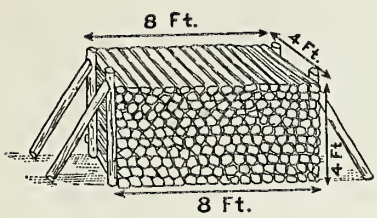


FIG. 1.

1. This picture shows a cord of wood.

2. Firewood is usually cut into sticks 4 ft. long. The length of the stick is the width of the pile. (See Fig. 1.)

3. A pile of wood 8 ft. long, 4 ft. wide, and 4 ft. high is called a **cord**. From the dimensions find how many *cubic feet* there are in a cord of wood.

128 cubic ft. = 1 cord (cd.)

4. How many cords are there in a pile of wood 16 ft. long, 4 ft. wide, and 8 ft. high.?

$\frac{16 \times 8 \times 4}{128}$

Divide the number of cubic feet in the pile by 128 cu. ft. to find the *number* of cords. Use cancelation.

5. How many cords are there in 2 piles of 4 ft. wood 12 ft. long, and 4 ft. high? What is it worth at \$6.25 a cord?

6. How many cords are there in 640 cu. ft.?

7. How many cords of wood can be piled on a car 18 ft. long, 8 ft. wide, and 7 ft. high?

8. Find the cost of a pile of wood 60 ft. long, 4 ft. wide, and 8 ft. high, at \$5.25 a cord?

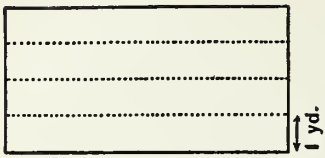
9. A pile of wood contains $6\frac{1}{2}$ cd. If this pile is 32 ft. long and $6\frac{1}{2}$ ft. high, how wide is it?

If $32 \times 6\frac{1}{2} \times x = 832$ cu. ft.,
then $832 \div (32 \times 6\frac{1}{2}) = x =$
$832 \times \frac{1}{32} \times \frac{2}{13} =$ ——.

Find the number of cubic feet in the given number of cords. Then find the missing dimension as indicated. Use cancelation to shorten the work.

10. At \$4.75 a cord, a pile of wood cost me \$28.50. How many cords were there? If the pile was 24 ft. long and 4 ft. wide, how high was it?

11. A pile of wood contains $4\frac{1}{2}$ cd. How long is it, if it is 7 ft. 6 in. high and 4 ft. wide?



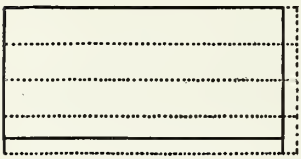
1. This diagram represents a room 24 ft. long and 12 ft. wide. If the carpet is 1 yd. wide, how many breadths running lengthwise will it take to cover the room? How long will each breadth be?

2. How do you find the number of breadths needed in a room when the breadths run lengthwise? When widthwise?

3. A room is 15 ft. wide and 20 ft. long. How many breadths of carpet, 1 yd. wide, will it take when they run lengthwise? How many yards will it take?

15 ft. ÷ 3 ft. = 5. No. of breadths.
20ft. = $6\frac{2}{3}$ yd. = Length.
$6\frac{2}{3}$ yd. × 5 = $33\frac{1}{3}$ yd.

Be careful that the width of the carpet and the dimensions of the room are of like denomination before dividing.



4. This diagram represents a room 24 ft. long, $10\frac{1}{2}$ ft. wide. How many breadths of carpeting, 1 yd. wide, will be needed? How long will each breadth be if there is a loss of 1 ft. on each breadth for matching?

$10\frac{1}{2}$ ft. ÷ 3 ft. = $3\frac{1}{2}$ ∴ 4 breadths.
24 ft. + 1 ft. = 25 ft. = $8\frac{1}{3}$ yd. length.
$8\frac{1}{3}$ yd. × 4 = $33\frac{1}{3}$ yd.

Since breadths of carpet are not split, it will be necessary to buy 4 breadths. Since there is a loss of 1 ft. on each breadth, each breadth must be 24 ft. + 1 ft. = 25 ft. long.

Find the cost of carpeting when breadths run lengthwise:

	Room.	Width of carpet.	Loss in matching.	Price a yard.
5.	15 ft. × 12 ft.	1 yd.	6 in.	$ .85
6.	30 ft. × 20 ft.	$\frac{3}{4}$ yd.	none	$1.12\frac{1}{2}$
7.	21 ft. × 16 ft.	1 yd.	18 in.	.75
8.	24 ft. × 15 ft.	$\frac{3}{4}$ yd.	$\frac{1}{8}$ yd.	.65
9.	22 ft. × 18 ft.	27 in.	6 in.	.90

The questions have been omitted from the problems in this lesson that the pupils may gain power in determining first *what* can be found from given data, and second, *how* to find it. Do not ask the questions for the pupils. Lessons designed for this purpose will be marked simply statements.

1. The divisor is 675, the quotient 488, and the remainder 548.

2. A man owns a rectangular garden plot 320 ft. long and 210 ft. wide.

3. Two men purchased a lot of wood for $31. In dividing the wood one man took $6\frac{1}{2}$ cords, and the other 9 cords.

4. A man had $12,000. He lost in business the first year $12\frac{1}{2}\%$ of it.

5. A square field is $61\frac{1}{2}$ rd. on each side. The fence that enclosed it cost $1.40 a rod.

6. A grocer bought 1150 gal. of molasses. After 12% leaked out, he sold the remainder at 65 ct. a gallon.

7. The price of $\frac{3}{4}$ of a ton of hay was $12.30. I bought $4\frac{1}{4}$ tons.

8. A man spent $646 for board and expenses. This was 34% of his salary.

9. Goods that cost $764 were sold at a loss of $17\frac{1}{2}\%$.

10. A piece of land is 120 ft. wide and 150 ft. long.

11. A man bought a horse for $72 and sold it for 25% more than it cost.

12. I bought 42 yd. of cloth. 35 yd. cost $12.25.

13. A farmer raised 55 bu. of potatoes. He sold 20% to one man, and 25% of the remainder to another man.

14. Property worth $7500 was insured at $1\frac{1}{2}\%$.

15. A woodpile is 20 ft. long, 4 ft. wide, and 6 ft. high. It cost $1.25 a cord for sawing it.

16. Oilcloth is $1\frac{1}{2}$ yd. wide and cost 75 ct. a yard. The room was $16\frac{1}{2}$ ft. long and 12 ft. wide.

1. How many board feet are there in 2 boards, each 14′ by 12″?

2. If 1 yd. of cloth costs $\$5\frac{1}{4}$, what will $\frac{2}{3}$ yd. cost?

3. If 5 bbl. of beef cost $\$17\frac{1}{2}$, what will $1\frac{1}{2}$ bbl. cost?

4. $\frac{2}{3}$ of 15 is $\frac{5}{7}$ of how many times 2?

5. What will 1 bu. of buckwheat cost if 3 pk. cost 48 cents?

6. How many times 8 are $1\frac{2}{3}$ of 26?

7. Express in common fractions in their lowest terms: 10%, 75%, 150%, $37\frac{1}{2}$%, $116\frac{2}{3}$%.

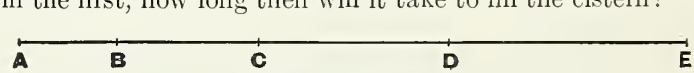
8. I bought 5 doz. oranges, but threw away 6, because they were poor. What per cent did I throw away?

9. If it takes $6\frac{3}{4}$ days for 1 man to do a piece of work, how long will it take 3 men to do the same work?

10. 6 added to a number equals 14. Find the number.

11. One pipe will fill a cistern in 4 hours and another in 6 hours. What part will each fill in an hour? What part will both fill in an hour? In how many hours will both pipes fill the cistern?

12. If water is running out of the second pipe while running in in the first, how long then will it take to fill the cistern?



13. AE represents —— miles.

14. AD represents —— miles.

15. AE − AD = —— miles.

16. AD − AC = —— miles. CD = —— miles.

17. AB + BC = —— miles, or AC = —— miles.

18. AB + AD = —— miles.

19. AE − (AB + BC) = —— miles.

20. AD + DE − (BC + CD) = —— miles.

21. AC + CD − (AB + BC) = —— miles.

1. The quotient is 71, the divisor 42, and the remainder 15. What is the dividend?

2. Multiply 160 by .016 and divide the product by .0025.

3. Divide $2\frac{1}{2}$ by $3\frac{1}{3}$ and multiply the quotient by $3\frac{1}{5}$.

4. A grocer bought 14 bags of coffee for \$142.24, but finding it damaged, he sold it at a loss of \$30.10. How much did he receive a bag?

5. A man lost $\$7\frac{1}{4}$ and found $\$5\frac{3}{4}$ of it. If he then had $\$24\frac{3}{5}$ how much had he at first?

6. A grocer sold $5\frac{3}{4}$ lb. of butter to one customer, $8\frac{7}{16}$ lb. to another, and $7\frac{7}{8}$ lb. to another. How many pounds of butter did he sell?

7. A farm of 50 acres is worth \$3000. How much is $\frac{3}{4}$ of an acre worth?

8. A grocer bought 535 lb. of sugar at $5\frac{1}{5}$ ct. a pound, and sold it at a profit of 15%. What did he receive for it?

9. $3\frac{1}{8}$ cents is what per cent of $12\frac{1}{2}$ cents?

10. If 2.25 tons of hay cost \$15.75, what will 5.75 tons cost?

11. If a vessel sails 325.5 miles in 46.5 hours, how many miles will she sail in $43\frac{3}{5}$ hours?

12. Find the cost of building a wall 110 ft. long, $2\frac{1}{2}$ ft. thick, and 10 ft. high, at 18¢ a cubic foot.

13. Find the cost of $416\frac{3}{8}$ cd. of wood at $\$4.87\frac{1}{2}$ a cord.

14. The area of a rectangle is 285,516 square yards. Its length is 924 yd. Find its width.

15. Divide fifty and five thousandths by five millionths.

16. What number beside 149 will exactly divide 11,771?

17. How many boards 10 ft. long and 12 in. wide will it take to build a tight board fence, 5 ft. high, round a lot 60 ft. by 120 ft.? Boards are nailed on perpendicularly. Each 10 ft. board will make how many fence boards?

18. What is the area of a triangle that has a base line of 80 ft. and whose vertex is 35 ft. above the base line?

1. One inch is —— —— of a foot. One inch is —— % of a foot.

2. 13 inches are —— —— of a foot more than a foot. 13 inches are —— % more than a foot. 13 inches are —— % of a foot.

3. 11 inches are —— —— of a foot less than a foot. 11 inches are —— % less than a foot.

4. Ten inches are ——% of a foot. Ten inches are ——% less than a foot.

5. One foot is —— —— of a yard. One foot is —— % of a yard.

6. One foot is —— —— of a yard less than a yard. One foot is —— % less than a yard.

7. 20% more than 25 means 25 + 20% of 25 = ——.

8. 25% less than 20 means 20 − 25% of 20 = ——.

9. Find a number that is 10% more than 50.

10. Find a number that is $33\frac{1}{3}$% less than 24.

11. 16 is —— more than 12. 4 is —— —— of 12. Then 16 is ——% more than 12.

12. Ethel had 30¢ and Rebecca has 36¢. Ethel's money is —— —— of Rebecca's money. Ethel's money is —— % of Rebecca's money.

13. Rebecca has —— cents more than Ethel. Rebecca's money is —— % (of Ethel's money) more than Ethel's money. Rebecca's money is —— % of Ethel's money.

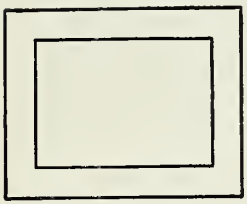
14. Ethel has —— cents less than Rebecca. Ethel has ——% (of Rebecca's money) less than Rebecca.

15. $33\frac{1}{3}$% of 24 is ——. 24 is $33\frac{1}{3}$% of ——. 24 is ——% of 72.

16. When $\frac{2}{3}$ of a yard of cloth is worth 12¢., 1 yd. is worth —— cents. $1\frac{1}{2}$ yd. are worth —— cents.

17. When $2\frac{1}{2}$ tons of coal cost $15, 1 ton costs $ ——. $\frac{1}{2}$ ton costs $ ——. $1\frac{1}{2}$ tons cost $ ——.

1. A park 100 rd. long, 80 rd. wide, is surrounded by a walk $16\frac{1}{2}$ ft. wide. How many square yards are there in the surface of the walk? If this walk is macadamized to a depth of 4 in., how many loads (1 cu. yd.) of material did it take?



Find the area of the entire park. Find the dimensions of the inner rectangle. Find the area of the inner rectangle. If you know the area of the outer and inner rectangles, how can you find the area of the walk? Be sure that all dimensions are of like denominations.

2. With a scale 1 in. to a foot, draw a figure to represent a square 4 ft. on a side. Inscribe within this a circle. (The circle must touch each of the 4 sides.) Find the area of the circle. Find the area of the part not included in the circle.

3. Find the number of square feet in the walls and ceiling of a room 28 ft. long, 20 ft. wide, and 12 ft. high. How much will it cost to plaster it at $33\frac{1}{3}$ ct. a square yard?

4. A farmer sold 525 bu. of wheat and 20% less of oats. How many bushels of oats did he sell? The wheat was sold at \$1.12 a bushel and the oats at 45 ct. a bushel. What did he receive for both?

5. A man bought 96 yd. of cloth at 40 ct. a yard and sold it at a gain of 20%. Find the selling price of each yard, and the amount received for all the cloth.

6. In one field there are 6 A. 80 sq. rd. If this is $\frac{1}{3}$ the number of acres in another field, find the number of acres there are in both fields.

7. A farmer bought a 12-acre field of wheat for \$225. The wheat yielded 28 bu. to an acre and was sold for $\$1.12\frac{1}{2}$ a bushel. He paid \$1.45 an acre for cutting, 5 ct. a bushel for thrashing, and \$1.75 a load (42 bu.) for teaming.

a. Find the total number of bushels of wheat, and selling-price.

b. Find the amount paid for cutting.

c. Find the sum paid for thrashing, and for teaming.

d. Find the total gain or loss.

1. If Nellie has twice as many plums as Mary and both have 18 plums, how many has each?

Let x = number of Mary's plums.
$2x$ = number of Nellie's plums.
$3x$ = 18 plums.
x = 6 plums.
$2x$ = 12 plums.

In examples like the above use the symbol x. This x stands in each example for any unknown quantity that we need to know to meet the conditions of the problem. In this problem x stands for the number of plums that Mary has. Why do we say $2x$ = number Nellie's plums? Where do we obtain $3x$ = 18 plums? If $3x$ = 18 plums, then x = —— of 18 plums = —— plums.

2. Jennie has 3 times as many pins as Grace and together they have 24 pins. How many has each?

3. John has a certain number of marbles and his brother 3 times as many. If they both have 40 marbles, how many has John? How many has his brother?

4. Charles has 5 times as many apples as Henry. If Henry has 24 apples less than Charles, how many has each?

5. Divide 82 into three parts, so that the second may be twice the first and the third twice the second.

NOTE: — In this example we see that the third part is compared with the second part, and the second part with the first part. Therefore, we should let x stand for which part? It should stand for the number that we need to know most, because the other numbers are compared with it.

6. A number added to 3 times itself is 16. What is the number?

7. A number subtracted from 4 times itself is 27. What is the number?

8. Nellie and Grace have 45 cents. If Nellie has 8 times as many cents as Grace, how many cents has each?

9. A fish pole and line are 24 ft. long. If the line is 2 times the length of the pole, how long is the pole?

10. Charles caught 3 trout, together weighing 48 oz. If the second one weighed twice as much as the first, and the third three times as much as the first, how much did each weigh?

1. A man paid \$960 for a carriage and span of horses, paying 3 times as much for the horses as for the carriage. How much did he pay for each?

2. A and B together had \$150 and B had four times as much money as A. How many dollars had each?

3. A man bought a harness and robe for \$45. The harness cost 4 times as much as the robe. What was the price of each?

4. Three men, A, B, and C, formed a company with a capital of \$6000. C put in 2 times as much as A, and B 3 times as much as A. How many dollars did each put in?

5. 108 marbles were divided among three boys. John had a certain number, James had three times as many as John, and Joseph had 5 times as many as John. How many did each boy have?

6. Divide \$81 among A, B, and C, so that B shall have 5 times as much as A, and C 3 times as much as A.

7. A horse and carriage are together worth \$450. The horse is worth twice as much as the carriage. What is each worth?

8. A man has 3 houses, which are together worth \$5400. The second is worth twice as much as the first, and the third is worth as much as the other two. Find the cost of each.

9. Divide \$216 among A, B, and C, so that B may have 3 times as much as A, and C may have 5 times as much as A.

10. Divide the number 136 into 3 parts such that the second shall be 3 times the first, and the third as much as the first and second.

11. Two rectangles contain 96 sq. ft. If the area of the second rectangle is 2 times that of the first, find the area of the second rectangle.

12. What are the dimensions of a rectangular field whose length is twice its width, if the whole perimeter is 168 rd.?

13. A house and lot cost \$13,600. The cost of the house was 16 times the cost of the lot. Find the cost of each.

1. I hired a horse of a livery man at the rate of $1 an hour. How much *horse hire* ought I to pay for the *use* of the horse for 5 hours?

2. I rent a house at the rate of $30 a month. How much *rent* ought I to pay for the *use* of the house for 6 months?

3. I borrowed $100 of Mr. B, at the rate of $6 for $100 for 1 year. How much *interest* ought I to pay for the *use* of Mr. B's money for one year?

4. **Interest** is money paid to the owner for the use of money.

5. Instead of saying " at the rate of $6 for $100 for one year," we usually say, " interest at 6%." The words " for one year " are understood.

6. What is 6% of $100? We see that "$6 for $100," or " interest at 6%," really mean the same thing.

7. I asked a man to lend me $200. He said he would, at 6%. What did he mean? How much interest ought I to pay him for a year?

8. The **principal** is the sum of money for which interest is paid.

9. In the 3d example, what was the principal? What was the interest?

10. If at the end of the year I paid Mr. B both principal and interest, what amount did I pay?

11. The **amount** is the sum of the principal and interest.

12. At 6% a year find the interest on $700 for 5 yr.

$700
.06
$42.00 int. for 1 yr.
5
$210.00 int. for 5 yr.

Multiply the principal by the rate to find the interest for one year.

Multiply the interest for one year by the number of years.

13. What is the interest of $500 at 5% for 1 year?

14. At 6% what is the interest of $200 for 2 years?

15. What is 1 year's interest of $400 at 4%?

At 4% find the interest of:

1. \$200 for 3 yr.
2. \$300 for 2 yr.
3. \$400 for 4 yr.
4. \$500 for 7 yr.
5. \$800 for 1 yr.
6. \$600 for 2 yr.
7. \$600 for $1\frac{1}{2}$ yr.
8. \$400 for $2\frac{1}{2}$ yr.

At 6% find the interest of:

9. \$500 for 6 yr.
10. \$300 for 3 yr.
11. \$800 for 2 yr.
12. \$900 for 1 yr.
13. \$600 for $1\frac{1}{2}$ yr.
14. \$400 for $2\frac{1}{2}$ yr.
15. \$500 for 1 yr. 6 mo.
16. \$200 for 2 yr. 6 mo.

At 5% find the interest of:

17. \$800 for 4 yr.
18. \$500 for 3 yr.
19. \$900 for 2 yr.
20. \$400 for 6 yr.
21. \$600 for 6 yr.
22. \$700 for 2 yr.
23. \$400 for 1 yr. 3 mo.
24. \$200 for $4\frac{1}{2}$ yr.
25. \$800 for 2 yr. 3 mo.
26. \$600 for $3\frac{1}{2}$ yr.

At 6% what is the interest of:

27. \$ 60 for 1 yr.? For 2 yr.? For 1 yr. 6 mo.?
28. \$ 40 for 2 yr.? For 4 yr.? For $1\frac{1}{2}$ yr.?
29. \$1000 for 5 yr.? For 3 yr.? For $2\frac{1}{2}$ yr.?
30. \$ 500 for 1 yr.? For 6 mo.? For 4 mo. ($\frac{1}{3}$ yr.)?

31. What is the amount in examples 17 to 26?

32. What is the interest of \$200 for 1 yr. at 4 %? What would it be for 2 yr. at 3%? For 3 yr. at 2%?

33. Mr. Scott borrowed of Mr. Brown \$500 at 4%, promising to pay the interest every 6 months. How much interest did he pay each time? If he kept the money 2 yr. 6 mo., how much interest did he pay for the entire time?

Find the interest of:

1. \$574 for 3 yr. at 6% For 5 yr. at 4%.
2. \$657 for 4 yr. at 7%. For 6 yr. at 3%.
3. \$730 for 5 yr. at 5%. For 4 yr. at 4%.
4. \$276 for 8 yr. at 3%. For 5 yr. at 6%.
5. \$406 for 3 yr. at 5%. For 6 yr. at 4%.

6. When one man borrows money of another he usually gives him a written promise to repay the money. This written promise is called a **promissory note.**

A Promissory Note

\$100 New Haven, May 12, 1909.

On demand I promise to pay to the order of

George W. Bishop

One Hundred ——— *Dollars*

with interest at 6%.

Value received. Chas. Whittaker.

7. In this note who promises to pay? To whom does he promise to pay? How much does he promise to pay?

8. The one who promises to pay is called the **promisor** or **maker.** He is also the **borrower.**

9. The one to whom the promise is made is called the **promisee** or **payee.** He is also the **lender.**

10. The sum of money named in the note is called the **face.** It is also the **principal** on which interest is to be paid.

11. In this note, who is the maker?

12. Who is the lender?

13. What sum of money is the face?

14. If Mr. Whittaker keeps the money one year, how much interest must he pay?

15. What will be the amount of the principal and interest?

16. Write a promissory note, making yourself promisor and one of your schoolmates the promisee.

1. If I pay 6 cents for the use of \$1 for 1 year, what part of the year can I keep the dollar and pay only one cent interest?

2. How many months is $\frac{1}{6}$ of the year? Then what is the interest of \$1 for 2 mo.?

3. Since \$.01 is the interest of \$1 for 2 months, the interest of \$8 will be 8 times \$.01 or \$.08. The interest of \$100 will be 100 times \$.01 or \$1.00.

4. To find the interest on any sum of money for 2 mo. or 60 days, at 6%, we move the decimal point two places to the left. This is the same as multiplying \$.01, the interest of \$1 for 2 mo., by the sum of money.

5. This method of computing interest is known as the 60-*day method,* and sometimes as the *banker's method.*

There are many methods of computing interest, no one of which is best for all examples. Since it seems unwise to burden the pupil's memory with different methods, we shall confine ourselves to the 60-day method, and the one illustrated in Lesson 62, which may be used in all examples where the time is given in years and months only.

Find the interest on the following sums of money for 2 *mo. at* 6%.

6.	\$60	7.	\$ 88	8.	\$305	9.	\$543	10.	\$5678
11.	30	12.	72	13.	475	14.	842	15.	4978
16.	48	17.	46	18.	267	19.	643	20.	9876
21.	39	22.	83	23.	394	24.	500	25.	4743
26.	62	27.	450	28.	412	29.	402	30.	3649
31.	79	32.	276	33.	516	34.	819	35.	6891
36.	12	37.	118	38.	618	39.	549	40.	4206
41.	24	42.	374	43.	728	44.	675	45.	2060
46.	31	47.	333	48.	175	49.	715	50.	1008
51.	43	52.	147	53.	379	54.	825	55.	7042
56.	54	57.	274	58.	741	59.	396	60.	3164

Note: — In all examples, unless otherwise stated, 6% is understood.

1. Find the interest of $500 for 6 mo.

$ 5.00 = int. for 2 mo.
$15.00 = int. for 6 mo.

First find the interest for 2 mo. by pointing off 2 places. Since 6 mo. is 3 times 2 mo., multiply the interest for 2 mo. by 3.

Note: — In working examples by this method do not write the multipliers.

2. After finding the interest for 2 mo., how would you find the interest for 4 mo.? 10 mo.? 1 yr. (12 mo.)?

3. Find the interest on $206 for 4 mo. 6 mo. 8 mo.

4. Find the interest on $640 for 10 mo. For 1 yr.

5. Find the interest for 6 mo. on $1800. On $2400.

6. Find the interest for 1 yr. on $750. On $375.

7. Find the interest for 1 yr. on $405. On $145.

8. What is the interest on $1216 for 8 mo.? Of $2445?

9. What is the interest on $800 for 9 mo.?

$ 8.00 = int. for 2 mo.
$32.00 = int. for 8 mo.
4.00 = int. for 1 mo.
$36.00 = int. for 9 mo.

First find the interest for 8 mo. Then for the odd month, which must be ½ of the interest for 2 mo.

10. Find the interest on $900 for 9 mo.

11. Find the interest on $400 for 7 mo. (6 mo. + 1 mo.)

12. Find the interest on $2200 for 1 yr. 3 mo.

$ 22.00 = int. for 2 mo.
$132.00 = int. for 1 yr.
22.00 = int. for 2 mo.
11.00 = int. for 1 mo.
$165.00 = int. for 1 yr. 3 mo.

First find the interest for 1 year, then for 2 mo. and 1 mo.

13. What is the interest on $3460 for 1 yr. 5 mo.?

14. What is the interest on $489 for 1 yr. 7 mo.?

1. Find the interest on \$1240 for 2 yr. 11 mo.

\$ 12.40 = int. for 2 mo.
\$ 74.40 = int. for 1 yr.
74.40 = int. for 1 yr.
62.00 = int. for 10 mo.
6.20 = int. for 1 mo.
\$217.00 = int. for 2 yr. 11 mo.

The solution sufficiently explains the method for finding interest for any number of years.

2. Find the interest on \$987.60 for 3 yr. 5 mo.

\$ 9.876 = int. for 2 mo.
\$ 59.256 = int. for 1 yr.
118.512 = int. for 2 yr.
19.752 = int. for 4 mo.
4.938 = int. for 1 mo.
\$202.458 = int. for 3 yr. 5 mo. \$202.46.

It is sufficiently accurate to retain only mills in the partial results, and express the final result to the nearest cent.

Find the interest on:

3. \$265 for 2 yr. 7 mo.

4. \$425 for 3 yr. 4 mo.

5. \$1464 for 1 yr. 6 mo.

6. \$5618 for 2 yr. 10 mo.

7. Find the interest on \$560 for 75 days.

\$5.60 = int. for 60 d.
1.40 = int. for 15 d.
\$7.00 = int. for 75 d.

Point off two places to find the interest for 2 mo., or 60 days. To find the interest for 15 days, we find $\frac{1}{4}$ of the interest for 60 days. Why?

8. Find the interest on \$480 for 25 days.

\$4.80 = interest for 60 d.
\$1.60 = int. for 20 d.
40 = int. for 5 d.
\$2.00 = int. for 25 d.

25 days = 20 d. + 5 d.
Int. for 20 d. = $\frac{1}{3}$ int. for 60 d.
Int. for 5 d. = $\frac{1}{4}$ int. for 20 d.

9. Find the interest on \$750 for 45 days.

10. Find the interest on \$1240 for 80 days.

11. Find the interest on \$246.50 for 75 days.

1. 6 days is what part of 60 days?

2. Since the interest of \$1 for 60 days at 6% is \$.01, the interest for 6 days will be $\frac{1}{10}$ of \$.01, or \$.001.

3. Since the interest on \$1 for 6 days is \$.001, the interest of \$10 will be 10 times \$.001 or \$.01. The interest of \$100 will be 100 times \$.001 or \$.10. The interest of \$600 will be 600 times \$.001 or \$.60.

Learn: To find the interest for 6 days on any sum of money move the decimal point 3 places to the left.

4. By pointing off 3 places find the interest for 6 days on the sums of money given in Lesson 65.

5. Find the interest on \$780 for 12 days.

\$ .78 int. for 6 d.
\$1.56 int. for 12 d.

By taking parts or multiples of the interest for 6 d., the interest for any number of days may be found.

6. Find the interest on \$1240 for 18 days.

7. Find the interest on \$520 for 15 days.

\$5.20 int. for 60 days. or
\$1.30 int. for 15 days.

\$ .52 int. for 6 d.
\$1.04 int. for 12 d.
.26 int. for 3 d.
\$1.30 int. for 15 d.

8. Find the interest on \$480 for 24 days.

9. Find the interest on \$697 for 12 days.

10. Find the interest on \$368 for 18 days.

11. Find the interest on \$846 for 1 yr. 2 mo. 12 d.

\$ 8.46 int. for 2 mo.
.846 int. for 6d.
\$50.76 int. for 1 yr.
8.46 int. for 2 mo.
1.692 int. for 12 d.
\$60.912 int. for 1 yr. 2 mo. 12 d.

Write the interest for 2 mo. and also for 6 days. Draw a line to separate them from the work below. Take such multiples or parts of these sums as will give the interest for the required time.

The following table will show the method of finding interest at 6% for any number of days.

1 day	= $\frac{1}{6}$ of 6 days.	16 days	= 15 d. + 1 d.
2 days	= $\frac{1}{3}$ of 6 days.	17 days	= 15 d. + 2 d.
3 days	= $\frac{1}{2}$ of 6 days.	19 days	= 18 d. + 1 d.
4 days	= 3 d. + 1 d.	20 days	= $\frac{1}{3}$ of 60 d.
5 days	= 3 d. + 2 d.	21 days	= 20 d. + 1 d.
7 days	= 6 d. + 1 d.	22 days	= 20 d. + 2 d.
8 days	= 6 d. + 2 d.	23 days	= 20 d. + 3 d.
9 days	= 6 d. + 3 d.	25 days	= 20 d. + 5 d.
10 days	= $\frac{1}{6}$ of 60 d.		or 24 d. + 1 d.
11 days	= 10 d. + 1 d.	26 days	= 24 d. + 2 d.
13 days	= 12 d. + 1 d.	27 days	= 24 d. + 3 d.
14 days	= 12 d. + 2 d.	28 days	= 24 d. + 3 d. + 1 d.
15 days	= 12 d. + 3 d. or $\frac{1}{4}$ of 60 d.	29 days	= 24 d. + 3 d. + 2 d.
		31 days	= 30 d. + 1 d.

1. Find the interest on \$475 for 1 yr. 1 mo. 5 d.

\$4.75	= int. for 60 d.
.475	= int. for 6 d.
\$28.50	= int. for 1 yr.
2.375	= int. for 1 mo.
.237	= int. for 3 d.
.158	= int. for 2 d.
\$31.270	= int. for 1 yr. 1 mo. 5 d.

Find the interest on :

2. \$1728 for 1 yr. 4 mo. 6 d.
3. 466.56 for 3 yr. 8 mo. 15 d.
4. 230.40 for 3 yr. 10 mo. 18 d.
5. 323.50 for 1 yr. 11 mo. 17 d.
6. 960 for 4 yr. 5 mo. 21 d.
7. 976.25 for 5 yr. 3 mo. 11 d.
8. 358.30 for 3 yr. 7 mo. 20 d.

Find the interest on the following:

1. \$475 for 1 yr. 2 mo. 5 d. For 2 yr. 3 mo. 7 d.
2. \$368 for 1 yr. 3 mo. 7 d. For 3 yr. 2 mo. 5 d.
3. \$694 for 1 yr. 4 mo. 8 d. For 4 yr. 5 mo. 7 d.
4. \$173.34 for 1 yr. 5 mo. 9 d. For 2 yr. 6 mo. 8 d.
5. \$25.60 for 1 yr. 7 mo. 10 d. For 1 yr. 6 mo. 9 d.
6. \$136.50 for 1 yr. 3 mo. 11 d. For 3 yr. 4 mo. 10 d.
7. \$97.50 for 1 yr. 11 mo. 13 d. For 4 yr. 5 mo. 12 d.
8. \$1264 for 1 yr. 9 mo. 14 d. For 3 yr. 3 mo. 13 d.
9. \$1478 for 1 yr. 5 mo. 15 d. For 2 yr. 7 mo. 14 d.
10. \$672 for 1 yr. 2 mo. 16 d. For 2 yr. 4 mo. 15 d.
11. \$47.95 for 1 yr. 3 mo. 17 d. For 3 yr. 9 mo. 16 d.
12. \$106.25 for 1 yr. 4 mo. 19 d. For 1 yr. 3 mo. 18 d.
13. \$16.48 for 1 yr. 5 mo. 20 d. For 2 yr. 4 mo. 19 d.
14. \$74.34 for 1 yr. 6 mo. 21 d. For 3 yr. 2 mo. 20 d.
15. \$1497 for 1 yr. 7 mo. 22 d. For 2 yr. 4 mo. 21 d.
16. \$748.25 for 1 yr. 8 mo. 23 d. For 4 yr. 8 mo. 22 d.
17. \$1200 for 1 yr. 9 mo. 25 d. For 3 yr. 3 mo. 23 d.
18. \$567 for 1 yr. 10 mo. 26 d. For 2 yr. 1 mo. 24 d.
19. \$1463 for 1 yr. 11 mo. 27 d. For 3 yr. 6 mo. 25 d.
20. \$1476.36 for 1 yr. 1 mo. 28 d. For 4 yr. 10 mo. 26 d.
21. \$1472.40 for 1 yr. 2 mo. 29 d. For 3 yr. 1 mo. 27 d.
22. \$1491.50 for 1 yr. 5 mo. 13 d. For 2 yr. 3 mo. 17 d.
23. \$2468 for 1 yr. 2 mo. 26 d. For 1 yr. 1 mo. 1 d.
24. \$680.50 for 1 yr. 3 mo. 27 d. For 1 yr. 5 mo. 16 d.
25. \$746.30 for 1 yr. 1 mo. 11 d. For 2 yr. 2 mo. 13 d.
26. \$123.40 for 1 yr. 7 mo. 19 d. For 5 yr. 3 mo. 15 d.
27. \$567.80 for 1 yr. 3 mo. 21 d. For 3 yr. 7 mo. 19 d.
28. \$912.30 for 1 yr. 4 mo. 17 d. For 4 yr. 2 mo. 21 d.
29. \$987.60 for 1 yr. 2 mo. 15 d. For 2 yr. 3 mo. 24 d.
30. \$876.50 for 1 yr. 6 mo. 16 d. For 3 yr. 4 mo. 25 d.

1. Find the interest on \$1200 for 1 yr. 2 mo. 18 d. at 5%.

\$12.00 = int. for 2 mo.
1.20 = int. for 6 d.
\$72.00 = int. for 1 yr.
12.00 = int. for 2 mo.
3.60 = int. for 18 d.
\$87.60 = int. at 6%.
14.60 = int. at 1%.
\$73.00 = int at 5%.

Find the interest at 6% in the usual manner. If \$87.60 is the interest at 6%, $\frac{1}{6}$ of \$87.60, or \$14.60, will be the interest at 1%. Then \$73.00, the difference between the interest at 6% and the interest at 1%, will be the interest at 5%.

2. How would you find the interest at 7%?

3. How would you find the interest at 3%?

4. What per cent must you add to 6% to get 8%? 2% is what part of 6%?

5. If you subtract $\frac{1}{3}$ of 6% from 6%, what per cent will you have?

6. The following table will show the method of finding interest at any rate, after first finding the interest at 6%:

$1\% = \frac{1}{6}$ of 6%.	$5\% = 6\% - \frac{1}{6}$ of 6%.
$2\% = \frac{1}{3}$ of 6%.	$7\% = 6\% + \frac{1}{6}$ of 6%.
$3\% = \frac{1}{2}$ of 6%.	$7\frac{1}{2}\% = 6\% + \frac{1}{4}$ of 6%.
$4\% = 6\% - \frac{1}{3}$ of 6%.	$8\% = 6\% + \frac{1}{3}$ of 6%.
$4\frac{1}{2}\% = 6\% - \frac{1}{4}$ of 6%.	$9\% = 6\% + \frac{1}{2}$ of 6%.

Find the interest on :

7. \$486.50 for 1 yr. 2 mo. 24 d. at 5%. At 7%. At 9%.
8. \$247.65 for 1 yr. 3 mo. 15 d. at 4%. At $7\frac{1}{2}\%$. At 8%.
9. \$1,264.30 for 1 yr. 5 mo. 13 d. at 5%. At $4\frac{1}{2}\%$. At 7%.
10. \$798.81 for 1 yr. 1 mo. 1 d. at 3%. At 4 %. At $7\frac{1}{2}\%$.
11. \$346.84 for 2 yr. 11 mo. 18 d. at 5%. At 7%. At 8%.
12. \$816.24 for 3 yr. 7 mo. 6 d. at 7%. At $4\frac{1}{2}\%$. At 5%.
13. \$745.00 for 1 yr. 10 mo. 10 d. at 6%. At 7%. At 8%.
14. \$225.75 for 1 yr. 4 mo. 11 d. at $4\frac{1}{2}\%$. At $7\frac{1}{2}\%$. At 7%.
15. \$268.80 for 2 yr. 3 mo. 14 d. at 5%. At 4%. At 6%.

Find the interest at 6% on :

1. \$100 for 1 yr.
2. \$100 for 1 yr. 6 mo.
3. \$100 for 1 yr. 6 mo. 6 d.
4. \$200 for 8 mo. 12 d.
5. \$200 for 10 mo. 18 d.
6. \$200 for 1 yr. 5 mo.
7. \$200 for 1 yr. 7 mo. 24 d.
8. \$300 for 4 mo. 18 d.
9. \$300 for 9 mo.
10. \$300 for 3 mo. 18 d.
11. \$400 for 6 mo. 12 d.
12. \$400 for 1 yr. 3 mo. 18 d.
13. \$500 for 7 mo.
14. \$500 for 1 yr. 2 mo.
15. \$600 for 10 mo. 24 d.
16. \$600 for 48 d.

17. $125\% = 1\frac{1}{4}$. Find 125% of 12, 20, 80, 120.

18. Find $66\frac{2}{3}\%$ of 27, 36, 48, 300.

19. Express in common fractions in the lowest terms:
10%, 75%, 150%, $37\frac{1}{2}\%$, $116\frac{2}{3}\%$, $87\frac{1}{2}\%$, $133\frac{1}{3}\%$.

20. Find 50% of \$72, $\$\frac{1}{2}$, $\$12\frac{2}{3}$, 4, 50%.

21. A man bought flour at \$5 a barrel, and sold it at a gain of 20%. Find his gain on each barrel. If he gained \$26 in all, how many barrels did he sell?

22. A merchant paid \$5.75 for an article and sold it at a profit of 20%. How much did he gain? For how much did he sell it?

23. What part of 12 is 6? Of 16 is 4? Of 12 is 2?

24. Substitute per cent for part in example 23, and give answers.

25. What part and what per cent of 10 is 5? Of 100 is 25? Of 500 is 50? Of 20 is 20? Of 120 is 40? Of 75 is 25?

26. 40 is 20% of what number? 12 is 6% of what number?

27. A man invested \$540 and lost \$90. What per cent did he lose?

28. From a herd of 300 cattle, the farmers of a certain town bought 50. What per cent of the herd did they buy?

29. A man bought a horse for \$200, and sold him so as to gain 10% of his cost. Find the gain and selling price.

1. A house which cost \$1200 was sold at a gain of 25%. What was the selling price?

2. Land which cost \$42 an acre was sold at a gain of $8\frac{1}{3}\%$. Find the selling price.

3. A fruit dealer bought apples at \$1.75 a barrel, and sold them at \$2.25 a barrel. What per cent did he gain?

4. A furniture dealer sold for \$2.76 a chair that cost him \$2.40. What per cent did he gain?

5. What is the net amount of a bill for \$2478 after a reduction of 5% has been made?

6. What is the cost of insuring 640 bbl. of flour, worth \$4 a barrel, if the cost of insurance is $\frac{1}{2}\%$ of the value of the flour?

7. A horse was bought for \$175. At what price must he be sold to gain 12%?

8. A merchant bought apples at \$1.20 a barrel and sold them at a gain of 25%. Find the selling price. How many barrels did he sell, if he received all together \$187.50?

9. A person gave \$1500 for a piece of land, and sold it at a gain of 20%. Find the selling price.

10. A man built a house for \$3500 and rented it for \$350 a year. For what per cent of its value did he rent it?

11. A quantity of goods was sold at a gain of $12\frac{1}{2}\%$. If the gain was \$34, what was the cost?

12. When the cost is \$8000, and the selling price \$7400, what is the rate of the loss?

13. A boy sold a sled for \$1.40, and by so doing lost $12\frac{1}{2}\%$. What did the sled cost?

14. Find the interest on \$224.38 for 2 yr. 9 mo. 21 d. at 7%.

15. A man's salary is \$2500 a year. He spends 30% for board, $12\frac{1}{2}\%$ for clothes, 20% for other expenses, and saves the rest. How much does he save?

16. Find the interest on \$716 for 1 yr. 5 mo. 12 d. at 5%.

17. An agent sold a house for \$8350. He kept 5% to pay for his services. How much commission did he keep?

1. How long will it take a man to save \$60, if he earns \$15 a week, and spends \$9 a week?

2. If $\frac{7}{8}$ of a yard of cloth costs 63 cents, what will $\frac{5}{9}$ of a yard cost?

3. A man sold a watch for \$120, which was $\frac{4}{5}$ of what it cost him. How much did it cost?

4. If 4 men can do a piece of work in 12 days, how long will it take 8 men to do it? Compare 8 men with 4 men.

5. If 4 pipes will fill a cistern in 40 min., how many pipes will fill it in 10 min.? Compare 10 min. with 40 min.

6. An agent sold \$300 worth of property, and charged 5% for so doing. How much did the agent receive?

7. Given the cost and loss per cent, what can be found?

8. A watch costing \$80 was sold at a loss of 10%. For how much was it sold?

9. What number increased by 12 equals 16?

10. State example 9 in another way.

11. What number diminished by 5 equals 9?

12. State example 11 in another way.

13. A milliner bought a hat for \$5 and sold it for \$6. What per cent did she gain?

14. If 20 is $\frac{1}{4}$ more than another number, it is how many 4ths of that number? What is the number?

15. If a pound of cheese costs 12¢, what will $2\frac{2}{3}$ lb. cost?

16. A man's salary is \$120 a month. If he spends $\frac{1}{3}$ of it for a watch, $\frac{1}{4}$ of it for a suit of clothes, and $\frac{1}{6}$ of it for board, how much of his salary remains?

17. If $\frac{1}{4}$ of a yard of cloth costs \$2, what will $2\frac{1}{2}$ yd. cost?

18. Find the interest on \$600 for 19 days at 6%.

19. $2\frac{1}{2}$ is $\frac{1}{4}$ of what number? $4\frac{1}{2}$ is 25% of what number?

20. What part of a pound is 12 oz.? 4 oz.?

21. Find the cost of 5 T., 400 lb., of coal, at \$5 a ton.

22. At 80¢ a bushel what is a peck and a half of corn worth?

1. Multiply eighty-four thousandths by thirty-six ten thousandths.

2. Divide five thousand two hundred thirty-two millionths by sixteen thousandths.

3. If the divisor is 675, the quotient 488, and the remainder 548, what is the dividend?

4. Find the interest on \$1763.25 for 1 yr. 3 mo. 14 d. at 6%.

5. If 24 men can do a piece of work in 9 days, in how many days can 18 men do it?

6. Find the interest on \$128.12 for 1 yr. 3 mo. 22 d. at 8%.

7. If a car runs $48\frac{1}{2}$ miles an hour, how far will it run in 16 days, running $14\frac{1}{2}$ hours a day?

8. Find the cost of $19\frac{4}{5}$ cd. of wood at $\$6\frac{1}{4}$ a cord.

9. A number diminished by 20% of itself is what per cent of itself? What number diminished by 20% of itself equals 936?

10. A dealer sold 438 tons of coal at \$4.75 a ton and a number of tons of another kind at \$5.20 a ton. He received for all \$4,254.10. How many tons did he sell?

11. If 18 tons of coal cost \$117, how many tons can be bought for \$234? Compare \$234 with \$117.

12. If $\frac{5}{9}$ of an acre of land can be bought for \$35, what is the value of $49\frac{3}{7}$ acres?

13. Find the difference between one hundred million, one hundred thousand one hundred and ninety million, ninety thousand ninety.

14. Multiply one hundred eighty-three thousand, six hundred by four hundred twenty-seven thousand.

15. Divide twenty-seven million, one hundred eighty thousand by fifteen thousand one hundred.

16. If the product of two numbers is 143,186,076, and one of the numbers is 32,871, what is the other number?

17. Two boys together have 260 marbles. If one boy has 4 times as many as the other, how many has each?

18. What are the prime factors of 5075?

1. If 9 lb. of figs cost \$1.08, what will 1 pound cost?

2. If 14 lb. of rice cost \$1.12, what will 1 lb. cost?

3. I have a number in my mind. If I take 15 from it, 35 will remain. What is the number?

4. When is the selling price more than the cost?

5. When is the selling price less than the cost?

6. When is the selling price equal to the cost?

7. When the gain is 20%, what is the selling per cent?

8. When the loss is 10%, what is the selling per cent?

9. Make change from three quarters for a 69¢ purchase.

10. Make change from a half dollar for a 31¢ purchase.

11. A man, working for a farmer at 20¢ an hour, received as full pay 4 bu. potatoes at 50¢ a bushel. How many hours did the man work?

12. If a man can do a piece of work in 4 days, what part of it can he do in 2 days?

13. By selling land at \$150 an acre I gained 25%. Find the cost.

14. A man paid \$500 for wheat and sold the whole at a loss of 6%. Find the loss. Find the selling price.

15. If 1 barrel holds $2\frac{1}{2}$ bu., how many barrels will it take to hold 25 bushels?

16. Divide $5\frac{3}{5}$ by $\frac{2}{5}$. Divide $6\frac{3}{5}$ by $\frac{3}{5}$.

17. At the rate of $\$7\frac{1}{2}$ a ton, what will 12 tons cost?

18. What is the difference between $\frac{1}{3}$ of 2 and $\frac{2}{3}$ of 1?

19. If 4 yd. of cloth cost 72¢., what will $\frac{7}{9}$ of a yard cost?

20. How many cubic feet are there in a box 4 ft. long, 3 ft. wide, and 2 ft. high?

21. If 8 is $\frac{2}{3}$ of a number, what is the number? What is $\frac{3}{4}$ of it?

22. $\frac{1}{4}$ of 80 is how many times 5?

23. If $\frac{2}{3}$ of a man's age is 18 years, how old is he?

24. At 20¢ a yard what will 45 ft. of ribbon cost?

1. Some goods that cost \$764 were sold at a loss of $17\frac{1}{2}\%$. Find the selling price.

2. Find the interest on \$800 for 2 yr. 6 mo. 15 d. at 6%.

3. Find the interest on \$750 for 3 yr. 3 mo. 3 d. at 5%.

4. If 35 yd. of cloth cost \$12.25, how much will 42 yd. cost?

5. Find the cost of $15\frac{1}{4}$ cd. of wood at $\$6\frac{3}{8}$ a cord, and of $7\frac{3}{4}$ cd. at $\$5\frac{3}{8}$ a cord.

6. A house costs \$6300, which is $1\frac{3}{4}$ times the cost of the lot. Find the cost of both house and lot.

7. Multiply the difference between 4.4 and .00027 by the product of 2.1 and .005.

8. Divide two-tenths by five ten-millionths.

9. Add $2\frac{1}{2}$, $3\frac{2}{7}$, $1\frac{11}{14}$, $7\frac{3}{14}$.

10. A can do a piece of work in 10 days, and B in 12 days. What part can each do in a day? What part can both do in a day? In what time can they do it by working together?

11. Multiply 630,000 by 3800.

12. Divide $816\frac{5}{12}$ by $16\frac{5}{6}$.

13. Multiply $13.703\frac{1}{3}$ by $.16\frac{5}{6}$.

14. Find the cost of $12\frac{1}{2}$ yd. of cloth at $34\frac{1}{8}$¢ a yard.

15. How many square feet are there in the floor of a room $17\frac{1}{2}$ ft. long and 16 ft. wide?

16. If $4\frac{1}{2}$ tons of coal cost \$18, what will 18 tons cost?

17. A paid \$10,500 for 125 acres of land. Find the cost of each acre. B bought 35 acres of land, paying \$6 more an acre than A paid. How much did B pay for his land?

18. What number divided by 453 will give the quotient 307 and the remainder 109?

19. How many yards of carpet $\frac{3}{4}$ yd. wide will it take to cover a floor 18 ft. 6 in. by 15 ft. 3 in., if the breadths run lengthwise?

20. At 45¢ a cubic yard find the cost of digging a ditch 22 ft. 9 in. long, 8 ft. 6 in. wide, and 8 ft. deep.

1. What is $8\frac{1}{3}\%$ of 48 books?

2. What is the interest on \$60 for 1 yr. 6 mo. at 5%?

3. Five boys bought a ball for 85¢ and sold it for 70¢. How much did each boy lose, if they divided the loss equally?

4. \$20 is $16\frac{2}{3}\%$ of what sum?

5. A rose garden is 12 ft. long and 9 ft. wide. Into how many plots, each containing 3 square feet, can the garden be divided?

6. At 45¢ a pound, how many pounds can be bought for \$1.35?

7. A merchant bought 5 boxes of butter for \$50 and sold them so as to gain \$10. What did he receive for each box?

8. Reduce: $\frac{17}{8}$, $\frac{24}{7}$, $\frac{37}{4}$, $\frac{25}{6}$, $\frac{15}{8}$, $\frac{35}{9}$.

9. Express decimally: $\frac{1}{2}$, $\frac{1}{3}$, $\frac{3}{4}$, $\frac{5}{8}$, $\frac{7}{20}$, $\frac{1}{5}$, $\frac{4}{5}$, $\frac{16}{25}$.

10. At five cents a yard, how many yards of cloth can be bought for five dollars?

11. A grocer paid \$60 for flour at \$5 a barrel, and sold it at \$5.75 a barrel. Find the entire gain.

12. At \$1.25 a barrel what will a farmer receive for 72 barrels of apples?

13. Compare a 2-inch square with 2 square inches, in respect to both their areas and perimeters.

14. Find the cost of $6\frac{1}{2}$ lb. of chicken at 12¢ a pound.

15. Find the cost of 6 lb. of steak at $16\frac{2}{3}$¢ a pound.

16. Compare $2\frac{1}{3}$ with 14. Compare $2\frac{1}{2}$ with 20.

17. Take $\frac{3}{5}$ of a number from it, and 18 remains. What is the number?

18. 20 is what per cent of 40? \$30 is what per cent of \$120?

19. Divide the following by 10: 17.2, 2.4, .26, 209.2.

20. How many half-inch cubes will it take to make a pile 2 in. on every side?

21. How many quater-inch squares can you place on a piece of paper 6 in. by 5 in.?

1. Goods that cost \$3072 were sold for \$2560.

2. A farmer sold 860 bu. of wheat at \$1.08 a bushel, and 20% less of oats at 52¢ a bushel.

3. A dealer sold 438 tons of coal at \$4.75 a ton, and a number of tons of another kind at \$5.20 a ton. He received for all \$4,254.10.

4. 2, 2, 5, and 7 are four of the five factors of 1680.

5. A owns $\frac{5}{9}$ of a ship and sells $\frac{3}{5}$ of his share for \$3600.

6. Two men had each \$420. One of them spent 15% and the other $18\frac{1}{2}$% of this sum.

7. A train leaves New Haven at 8.45 A.M. and goes $27\frac{1}{3}$ miles an hour. Another train follows at 9 A.M. and goes 41 miles an hour.

8. An article cost \$90. It was sold at a gain of $12\frac{1}{2}$%.

9. A rectangular tank of water is 25 ft. long, 18 ft. wide, and 16 ft. 9 in. deep.

10. A merchant sold a lot of goods for \$129 at a loss of $33\frac{1}{3}$%.

11. The same merchant sold another lot for \$73.85 at a gain of $16\frac{2}{3}$%.

12. A owns 15% of a business; B, 25%; C, 28%, and D, the remainder. D's share is worth \$17,232.

13. A merchant sold 12 bbl. of pork, averaging 200 lb. a barrel, at 12¢ a pound, and took in payment 160 hams, weighing 10 lb. each.

14. $\frac{3}{8}$ of a farm is in grass land, $\frac{5}{16}$ in corn, and $\frac{1}{4}$ in wheat. The rest of the farm, which is 16 acres, is in oats.

15. I own $\frac{2}{3}$ of a farm; $\frac{3}{4}$ of my share is worth \$420.

16. The length of an oblong is 26 ft. and the width is 14 ft.

17. A man owned 156 acres of land, and sold 75% of it for \$5265.

18. The circumference of a circular garden is 180 rd.

19. A and B together have 2538 acres of land. B has five times as much as A.

1. A **denominate number** is a concrete number denoting measure or weight, as 4 pounds, 6 quarts, etc.

2. A **unit of measure** is a definite unit, established by law or custom, used in measuring quantity. Thus 1 bushel, 1 foot, are units of measure, and 1 pound is a unit of weight.

3. A **simple denominate number** is a denominate number expressed in terms of a single unit of measure, as 7 yd., 12 oz., 3 qt., etc.

4. A **compound denominate number** is a denominate number expressing more than one denominate unit related to each other, as 5 ft. 6 in.; 4 gal. 2 qt. 1 pt.

5. **Compound numbers** is the term usually given to compound denominate numbers.

6. **Reduction** is the changing from one form to another without changing the value, as 2 lb. 8 oz. may be expressed as $2\frac{1}{2}$ lb., or as 40 oz.

7. In changing 2 lb. 8 oz. to ounces we change to a lower denomination. This process is called **reduction descending.**

8. In changing 40 oz. to pounds we change to a higher denomination. This process is called **reduction ascending.**

TABLES FOR STUDY AND REFERENCE

LIQUID MEASURE

4 gills (gi.) = 1 pint (pt.)
2 pints = 1 quart (qt.)
4 quarts = 1 gallon (gal.)

A gallon contains 231 cu. in.
For general purposes it is sufficiently accurate to call $7\frac{1}{2}$ gal. equal to a cubic foot. 31.5 gal. are considered a barrel, and 2 bbl. a hogshead.

DRY MEASURE

2 pints (pt.) = 1 quart (qt.)
8 quarts = 1 peck (pk.)
4 pecks = 1 bushel (bu.)

A bushel, even measure, contains 2150.42 cu. in.
A bushel, heaped measure, contains 2688 cu. in. It is sufficiently accurate to say there are $1\frac{1}{4}$ cu. ft. in an even bushel, and $1\frac{1}{2}$ cu. ft. in a heaped bushel. The even bushel is used in measuring all kinds of grain and the heaped bushel in measuring all kinds of fruits or vegetables.

MEASURE OF LENGTH OR LONG MEASURE

12 inches (in.)	= 1 foot (ft.)
3 feet	= 1 yard (yd.)
$5\frac{1}{2}$ yards or $16\frac{1}{2}$ feet	= 1 rod (rd.)
320 rods or 5280 feet	= 1 mile (mi.)

NOTE: — 6′ is often written for 6 ft., and 6″ for 6 in.

A *hand* is 4 in., used in measuring the height of horses.

A *fathom* is 6 ft., used in measuring the depth of water.

A *knot* or nautical mile is 1.15 miles, and a *league* is 3 miles, both used in measuring distances at sea.

A *pace* is 3 ft., used in estimating distances.

A *chain* is 66 ft., used by surveyors.

MEASURE OF SURFACE OR SQUARE MEASURE

144 square inches (sq. in.)	= 1 square foot (sq. ft.)
9 square feet	= 1 square yard (sq. yd.)
$30\frac{1}{4}$ square yards	= 1 square rod (sq. rd.)
160 square rods	= 1 acre (A.)
640 acres	= 1 square mile (sq. mi.)

A *section* of land is 1 mile square.

A *square* is 100 sq. ft. of roofing.

MEASURE OF VOLUME OR CUBIC MEASURE

1728 cubic inches (cu. in.)	= 1 cubic foot (cu. ft.)
27 cubic feet	= 1 cubic yard (cu. yd.)
128 cubic feet	= 1 cord (cd.)

A *perch* is usually $24\frac{3}{4}$ cu. ft., used in measuring stones and masonry.

A *load* is 1 cu. yd., used by contractors in excavating earth for cellars, etc.

A *brick* is 8 in. long, 4 in. wide, and 2 in. thick; 22 bricks are estimated as equal to 1 cu. ft.

MEASURE OF WEIGHT OR AVOIRDUPOIS WEIGHT

16 ounces (oz.) = 1 pound (lb.)
100 pounds = 1 hundredweight (C.)
2000 pounds = 1 ton (T.)

A *long ton* is 2240 lb., used in buying coal at the mine and by custom-house offices in collecting duties. A barrel of flour weighs 196 lb. A bushel of oats weighs 32 lb., corn 56 lb., wheat or potatoes 60 lb.

TABLE OF TIME MEASURE

60 seconds (sec.) = 1 minute (min.)
60 minutes = 1 hour (hr.)
24 hours = 1 day (d.)
7 days = 1 week (wk.)
12 months (mo.) = 1 year (yr.)

"Thirty days hath September
April, June, and November."

The other months have 31 days, except February, which has 28 days in common years and 29 days in leap years. All years divisible by 4 are leap years except centennial years, these only are leap years when divisible by 400.

A *decade* is 10 years, and a *century* is 100 years.

TABLE OF VALUE OR UNITED STATES MONEY

10 mills = 1 cent (ct. or ¢)
10 cents = 1 dime
10 dimes = 1 dollar ($)

The mill is not coined, but we frequently use the term in speaking of fractional parts of a cent.

TABLES FOR COUNTING

20 units = 1 score	24 sheets of paper = 1 quire
12 units = 1 dozen (doz.)	20 quires = 1 ream
12 dozen = 1 gross (gro.)	

Paper is often sold by the pound instead of the quire or ream.

A folio is paper folded into 2 leaves in making books; a quarto or 4to is folded into 4 leaves; an octavo or 8vo into 8 leaves, and a duodecimo or 12mo into 12 leaves.

The tables of Troy Weight, used by goldsmiths, and Apothecaries Weight, used by physicians and druggists, are of too little importance to include them in the list of tables. The table for Circular Measure will be presented in connection with Longitude and Time or the study of circles.

REDUCTION. ORAL EXERCISES

Change :

1. 8 bu. to pecks.
2. 3 pk. to quarts.
3. 56 qt. to pecks.
4. 16 pk. to bushels.
5. 12 gal. to quarts.
6. 20 qt. to pints.
7. 36 qt. to gallons.
8. 80 pt. to quarts.
9. 9 ft. to inches.
10. 15 yd. to feet.
11. 33 ft. to yards.
12. 144 in. to feet.
13. 11 yd. to rods.
14. 2 mi. to rods.
15. 8 sq. yd. to square feet.
16. 81 sq. yd. to square feet.
17. 2 acres to square rods.
18. $60\frac{1}{2}$ sq. yd. to square rods.
19. 48 oz. to pounds.
20. 4 lb. to ounces.
21. 120 min. to hours.
22. 5 hr. to minutes.
23. 84 days to weeks.
24. 10 yr. to months.
25. 48 hours to days.
26. 3 min. to seconds.
27. 4 score to units.
28. 5 reams to quires.
29. 1 gross to units.
30. 2 quires to single sheets.

1. Change 20 gal. 3 qt. 1 pt. to pints.

Analysis

1 gal. = 4 qt.
20 gal. = 20 × 4 qt. = 80 qt.
80 qt. + 3 qt. = 83 qt.
1 qt. = 2 pt.
83 qt. = 83 × 2 pt. = 166 pt.
166 pt. + 1 pt. = 167 pints.

Usual Method

20
4
80 = the number of quarts in 20 gal.
3
83 = the number of quarts in 20 gal. 3 qt.
2
166 = the number of pints in 83 qt.
1
167 = the number of pints in 83 qt. 1 pt.

Change:

2. 5 reams, 10 quires, 18 sheets, to sheets.
3. 7 T. 25 lb., 12 oz. to ounces.
4. 4 wk. 6 days, 12 hours to hours.
5. 9 hr. 45 min. 50 sec. to seconds.
6. 7 cu. yd. 15 cu. ft. 750 cu. in. to cubic inches.
7. $7\frac{1}{2}$ cords to cubic ft.
8. 3 acres, 40 sq. rd. to square rods.
9. 17 sq. rd. 15 sq. yd. 7 sq. ft. to square feet.
10. 28 sq. yd. 8 sq. ft. 91 sq. in. to square inches.
11. 7 mi. 180 rd. 3 yd. to yards.
12. 160 rd. 4 yd. 2 ft. to feet.
13. 5 mi. 15 ft. to feet.
14. 4 yd. 2 ft. 9 in. to inches.
15. 476 leagues to miles.
16. 96 fathoms to feet.
17. 6 gal. 3 qt. 1 pt. to pints.
18. 3 qt. 1 pt. 2 gi. to gills.
19. 17 bu. 3 pk. to pecks.
20. 24 bu. 2 pk. 7 qt. to quarts.
21. $7, 4 dimes, 8 cents to cents.

1. Draw a line on the blackboard 1 yd. long.

2. Draw a line on the floor 1 rod long. Walk the length of the line counting your steps.

3. In another part of the room *pace* a rod. Measure the distance, correcting the error if any.

4. Cut a string 165 ft. or 10 rd. long. With this measuring string mark off various distances from the schoolhouse, as 40 rd. or $\frac{1}{8}$ m., 80 rd. or $\frac{1}{4}$ m., 160 rd. or $\frac{1}{2}$ m., 1 mile.

5. Practice estimating these different distances, then pace them to correct your estimate.

6. Mark off a square rod on the floor or in the yard.

7. With your measuring string in some park or vacant lot mark off a rectangle 16 rd. $\times$ 10 rd., or 20 rd. by 8 rd. This is 1 acre.

8. Compare the schoolyard with the acre. Compare your home lot with the acre.

NOTE: — Give the pupils much practice in visualizing the longer measures of length and surface.

Change:

9. 144 units to dozens.
10. 80 quires to reams.
11. 850 cents to dimes.
12. 600 cents to dollars.
13. 12 leagues to miles.
14. 24 ft. to fathoms.
15. 2 chains to feet.
16. 84 mo. to years.
17. 48 hr. to days.
18. 360 min. to hours.
19. 8000 lb. to tons.
20. 84 gills to pints.
21. 320 qt. to pecks.
22. 22 yd. to rods.
23. 165 ft. to rods.
24. 36 ft. to yards.
25. 1280 A. to square miles.
26. $90\frac{3}{4}$ sq. yd. to square rods.
27. 15 gal. will fill how many cubic feet?
28. 4 heaped bushels will fill how many cubic feet?
29. 8 even bushels will fill how many cubic feet?
30. 9 cu. yd. will make how many loads?

1. Reduce 167 pints to gallons, quarts, and pints.

2)167 pt.
4)83 + 1 pt.
20 + 3 qt.
20 gal. 3 qt. 1 pt.

Since 2 pt. equal 1 qt., 167 pt. will equal 83 qt. and 1 pt. remaining.

Since 4 qt. equal 1 gal., 83 qt. will equal 20 gal. and 3 qt. remaining. Hence 167 pt. = 20 gal. 3 qt. 1 pt.

Reduce to units of higher denomination:

2. 211 gills	**3.** 193 pt. (liquid)	**4.** 87 pt. (dry)
5. 124 qt. (dry)	**6.** 236 oz.	**7.** 9236 lb.
8. 2348 sec.	**9.** 3245 min.	**10.** 1920 hr.
11. 4672 in.	**12.** 162 ft.	**13.** 95 yd.
14. 2958 rd.	**15.** 2046 sq. in.	**16.** 248 sq. ft.
17. 286 sq. yd.	**18.** 815 sq. rd.	**19.** $76\frac{1}{2}$ pk.
20. 8463 cu. in.	**21.** 374 cu. ft.	**22.** 4515 lb.

23. How many pounds are there in $\frac{5}{8}$ of a ton?
Solution: $\frac{5}{8}$ of 2000 lb. = 1250 lb.

24. In $1\frac{1}{2}$ gal. there are how many quarts?

25. In $\frac{3}{7}$ mi. there are how many rods?

26. How many pecks are there in $\frac{3}{4}$ bu.?

27. Change $\frac{5}{7}$ cu. yd. to cubic feet.

28. Change $\frac{3}{5}$ A. to square rods.

29. Change .$8\frac{1}{3}$ yd. to feet.
Solution: 3 ft. multiplied by .$8\frac{1}{3}$ = 2.5 ft.

30. Change .6875 gal. to quarts.

31. Change .75 yr. to months.

32. Change .625 hr. to minutes.

33. How many days are there in $\frac{1}{2}$ of a week?

34. $\frac{1}{5}$ of a day is how many hours and minutes?

35. In .375 gal. there are how many quarts?

36. Change .625 sq. mi. to square rods.

1. Add : 4 bu.
5 bu.
9 bu.

2. Add : 3 pk.
2 pk.
5 pk.

3. Add : 7 qt.
5 qt.
12 qt.

4. Add :

4 bu.	3 pk.	7 qt.
5 bu.	2 pk.	5 qt.
9 bu.	5 pk.	12 qt.
10 bu.	2 pk.	4 qt.

The first three examples are arranged in the fourth as parts of one compound number. The result of the addition is 9 bu. 5 pk. 12 qt. 12 qt. = 1 pk. 4 qt. Write the 4 qt. Unite the 1 pk. with 5 pk. making 6 pk. 6 pk. = 1 bu. 2 pk. Write the 2 pk. and unite the 1 bu. with the 9 bu. making 10 bu.

5. Add : 18 gal. 3 qt.; 60 gal. 3 qt. 1 pt.; 61 gal. 3 qt.; 57 gal. 3 qt. 1 pt.

6. Add : 15 da. 23 hr. 55 min. 17 sec.; 13 da. 15 hr. 17 min. 38 sec.; 10 da. 23 hr. 42 min. 12 sec.

7. Add :

mi.	rd.	ft.	in.
21	295	11	1
45	279	10	11
35	214	9	10

8. Add :

bu.	pk.	qt.
85	3	7
9	2	5
98	0	6

9. How much wood is there in three piles, if the first contains 12 cd. 17 cu. ft., the second 9 cd. 12 cu. ft., and the third 20 cd. 98 cu. ft.?

10. Add : 57 A. 25 sq. rd.; 129 A. 15 sq. yd.; 37 A. 50 sq. rd. 13 sq. yd.; 75 A. 12 sq. yd.

11. Add : 5 gal. 3 qt. 1 pt.; 9 gal. 1 qt. 1 pt.; 7 gal. 3 qt. 1 pt.; 5 gal. 2 qt.

12. Add : 12 bu. 2 pk. 5 qt.; 15 bu. 3 pk. 3 qt.; 29 bu. 2 pk.; 17 bu. 2 qt.

13. Add: 24 rd. 5 yd. 1 ft.; 4 yd. 10 in.; 86 rd. 3 yd. 2 ft.

14. Add : 110 cu. yd. 7 cu. ft.
78 cu. yd. 13 cu. ft.
94 cu. yd. 21 cu. ft.
108 cu. yd. 11 cu. ft.

15. Add : 17 T. 125 lb.
34 T. 750 lb.
19 T. 800 lb.
76 T. 500 lb.

1. Take 8 bu. 3 pk. 7 qt. from 15 bu. 1 pk. 5 qt.

15 bu. 2 pk. 5 qt.
8 bu. 3 pk. 7 qt.
6 bu. 2 pk. 6 qt.

or

14 bu. 5 pk. 13 qt.
8 bu. 3 pk. 7 qt.
6 bu. 2 pk. 6 qt.

Since we cannot take 7 qt. from 5 qt., we take 1 pk. from the 2 pk. and put it with 5 qt., making 13 qt. 13 qt. − 7 qt. = 6 qt. In the same way 1 bu. is changed to pecks and united with 1 peck, making 5 pk. 5 pk. − 3 pk. = 2 pk. 14 bu. − 8 bu. = 6 bu. If thought best, 15 bu. 2 pk. 5 qt. may be changed immediately to 14 bu. 5 pk. 13 qt., as in the second illustration.

2. From 46 gal. 1 qt. 1 pt. take 25 gal. 2 qt. 1 pt.

3. Take 160 T. 1800 lb. from 175 T. 298 lb.

4. From 8 bu. 1 pk. 6 qt. take 3 bu. 2 pk. 4 qt.

5. From 471 cu. yd. 16 cu. ft. take 115 cu. yd. 17 cu. ft.

6. From 19 yr. 5 mo. take 12 yr. 9 mo.

7. How long was it from July 15, 1907, to Feb. 6, 1909?

1909 yr. 2 mo. 6 d.
1907 yr. 7 mo. 15 d.
1 yr. 6 mo. 21 d.

From the 6th day of the second month of 1909 take the 15th day of the seventh month of 1907. Take one of the 2 mo., which is 30 d., and unite it with the 6 d., making 36 d. 36 d. − 15 d. = 21 d. Take one year, or 12 mo., and unite it with 1 mo., making 13 mo. 13 mo. − 7 mo. = 6 mo. 1908 yr. − 1907 yr. = 1 yr.

Find the difference in time between :

8. June 8, 1907 and Aug. 15, 1910.

9. Feb. 23, 1906 and April 6, 1909.

10. Jan. 5, 1907 and March 26, 1910.

11. Sept. 15, 1908 and March 16, 1910.

12. Apr. 18, 1909 and Jan. 25, 1911.

13. Nov. 13, 1908 and May 2, 1911.

14. A man sold 42 T. 1500 lb. of hay from a mow containing 64 T. How much hay remained?

15. Subtract your birthday from to-day and find your exact age in years, months, and days.

1. Multiply 7 bu. 3 pk. by 6.

7 bu. 3 pk.
6
42 bu. 18 pk.
46 bu. 2 pk.

Multiply each denomination separately. The result is 42 bu. 18 pk. Beginning with the lowest denomination, change, when possible, to the next higher denomination. 18 pk. = 4 bu. 2 pk. Write the 2 pk. and add the 4 bu. to 42 bu.

2. What is the weight of 9 loads of hay, each weighing 1 T. 545 lb.?

3. If it takes 4 days 5 hr. to build a machine, how long will it take to build 24 machines?

4. How much wood is there in 12 piles, each containing 10 cd. 50 cu. ft.?

5. If a man can build 11 rd. $7\frac{1}{2}$ ft. of fence in a day, how much can 8 men build?

6. If 16 automobiles in the Glidden endurance test of 1909 stopped at Station B, and each received 6 gal. 3 qt. of gasoline, how much gasoline did all receive?

7. A driving track measures 180 rd. 10 yd. in length. How much more than 2 miles has a horse traveled in going round this track 4 times?

8. Multiply 5 ft. 3 in. by 4 ft. 6 in.

63 sq. in.
54
144)3402 sq. in.
23.625 sq. ft.

Reduce the compound numbers to the same denomination. 5 ft. 3 in. = 63 in. 4 ft. 6 in. = 54 in. (63 × 54) sq. in. = 3402 sq. in. 3402 sq. in. ÷ 144 sq. in. = 23.625, hence there are 23.625 sq. ft.

Find the area of:

		Base.	Altitude.
9.	A rectangle	17 ft. 2 in.	15 ft. 6 in.
10.	A triangle	13 ft. 9 in.	10 ft. 4 in.
11.	A rectangle	40 rd. 5 yd.	24 rd. 4 yd.
12.	A triangle	18 yd. 1 ft.	16 yd. 2 ft.
13.	A rectangle	12 rd. 9 ft.	8 rd. 8 ft.

1. Divide 50 bu. 4 pk. by 6.

8 bu. 2 pk.
6)50 bu. 4 pk.
48 bu.
2 bu.
4
8 pk.
4 pk.
12 pk.
12 pk.

$\frac{1}{6}$ of 50 bu. = 8 bu. and 2 bu. remaining. Write the 8 bu. above the bushels. The remaining 2 bu. = 8 pk. 8 pk. + 4 pk. = 12 pk. $\frac{1}{6}$ of 12 pk. = 2 pk. The result is 8 bu. 2 pk.

Divide:

2. 17 hr. 32 min. 24 sec. by 4.

3. 23 sq. yd. 9 sq. ft. 117 sq. in. by 9.

4. 89 bu. 1 pk. 7 qt. by 7.

5. 332 lb. 8 oz. by 19.

6. 115 T. 476 lb. 12 oz. by 28.

7. 36 gal. 3 qt. 1 pt. by 9.

8. Divide 13 ft. 6 in. by 4 ft. 6 in.

3
54 in.)162 in.
162

Change both numbers to the same denomination. 13 ft. 6 in. = 162 in. 4 ft. 6 in. = 54 in. 54 in. is contained in 162 in. 3 times.

9. How many packages containing 2 lb. 4 oz. can be made from 11 lb. 4 oz.?

10. If the circumference of a carriage wheel is 9 ft. 6 in., how many revolutions will the wheel make in going a mile?

11. The area of a rectangle is 137 sq. ft. 72 sq. in. If the length is 16 ft. 6 in., what is the width?

12. The area of a rectangle is $114\frac{3}{4}$ sq. ft. If the length is 25 ft. 6 in., what is the width?

13. How many planks, each 4 ft. 8 in. long, will it take to reach 38 ft.?

1. The length of a rectangle is 1 rd. 5 ft. and its width is 66 in. Find the length and width in feet and its area in square feet.

2. A horse is $13\frac{1}{2}$ hands high. How many inches high is it? How many feet and inches?

3. What is the breadth of a rectangular field containing $7\frac{1}{2}$ acres, if the length is 242 yards?

4. A rectangular yard is 28 ft. 8 in. long and 24 ft. 9 in. wide. How many square feet are there in its area? What will it cost to sod it at 75¢ a square yard?

5. How many rods of fence will enclose a rectangular field of 20 acres, if its width is 40 rd.?

6. A pile of wood 9 ft. high and 4 ft. wide contains 20 cords. How long is it?

7. How many cubic feet of ice are there on a pond covering 1 acre, if the ice is $1\frac{1}{4}$ ft. thick? If a cubic foot of ice weighs 57 lb. 8 oz., how many tons will this ice weigh?

8. If ice retails at 40¢ a hundred, find the value of the ice on the pond.

9. From a lot of land 40 rd. square, 40 square rods were sold. How many square rods remained? Find its value at $120 an acre.

10. Find the number of cubic feet in a rectangular prism $12\frac{1}{2}$ yd. by 10 ft. by 16 in.

11. Find the circumference of a circle whose diameter is 75 feet. Find the area of the same circle.

12. At $1.20 a bushel find the cost of 12 bu. 3 pk. 1 qt. of beans.

13. What is the cost of 6340 lb. of coal at $6.25 a ton?

14. Change 948,741 min. to higher denominations.

15. Reduce 5 gal. 2 qt. 1 pt. to pints.

16. Find the time from Nov. 29, 1909, to April 1, 1911.

17. Find the area of a triangle $6\frac{2}{3}$ yd. long, if the altitude is 8 ft. 4 in.

1. A merchant sold his horse for $200 and by so doing lost 20%. Find the value of the horse.

2. Grace gave $\frac{1}{2}$ of her oranges to her mother and $\frac{1}{3}$ of them to her father. What part did she keep? What per cent had she left?

3. If you sell an article for $12\frac{1}{2}¢$ that cost $10¢$, how much will you gain? What will be your rate of gain?

4. When there is neither gain or loss what is the selling per cent?

5. What is the amount of $60 for 60 days?

6. What is the interest on $100 for 1 yr.? For 2 yr.? 1 yr. 6 mo.? 2 yr. 3 mo.?

7. A grocer sold tea at $50¢$ a pound and gained 25%. The tea cost —— a pound.

8. Ten bushels out of 100 bushels is what per cent?

9. $1 out of every $10 is what per cent?

10. $5 out of every $20 is what part? Is how many hundredths? Is what per cent?

11. A man receiving a salary of $2400 spends $33\frac{1}{3}\%$ of it for expenses. His expenses are ——.

12. $\frac{2}{5}$ of $1 equals —— hundredths of it. This is ——% of it.

13. $\frac{1}{2}$ of a farm is —— hundredths of it. It is what per cent of it?

14. If 18 is 6% of some number, what is 1% of it? What is 100% of it? What is the number?

15. If 5 is $33\frac{1}{3}\%$ of a number, it is what part of the number? Then $\frac{3}{3}$ or the number is ——.

16. Express as decimals, 6%, 25%, $12\frac{1}{2}\%$, 150%, 275%, 0.5%, $0.1\frac{1}{2}\%$.

17. A foot is what per cent of a yard?

18. An inch is what per cent of a foot?

19. A quart is what per cent of a gallon?

1. A man paid \$2500 for a piece of property and sold it at a discount (loss) of 20%. What was the discount and how much did he receive for it?

2. A typewriter was bought for \$80 and sold at a discount of $12\frac{1}{2}\%$. Find the selling price.

3. From a lot of 350 chickens 24% were sold. How many chickens remained?

4. A merchant bought \$900 worth of goods at 7% discount. How much did he pay for the goods?

5. A man sold a piece of property at a profit of \$700, which was 35% of the cost. What did he receive for it?

6. A man sold 33 sheep, which was 44% of his whole flock. How many did he have left?

7. There are 760 pupils in a school. If 55% of them are boys, how many girls are there?

8. A grocer bought 112 barrels of flour at \$4.25 a barrel and sold them at a profit of 24%. Find the selling price per barrel and the gain on the lot.

9. A dealer bought horses at \$120 and sold them at \$185 each. What per cent profit did he gain?

10. A merchant sold 75 yd. of silk that cost \$1.10 a yard at a gain of 50%. Find the selling price a yard and the gain on all the silk.

11. A man receives a salary of \$1600. If he spends 68% of it each year, how much can he save in 5 years?

12. A woman spent 19% of her money for a suit that cost \$47.50. How much money did she have left?

13. A grocer bought flour for \$350 and sold it at a profit of 24%. Find the sum received for it.

14. If 65% of a ton of hay is worth \$10.92, how much must be paid for 45% of a ton?

15. Find the interest on \$252.64 for 3 yr. 9 mo. 19 d. at 7%.

16. Find the interest on \$539.50 for 2 yr. 5 mo. 16 d. at 4%.

1. A sailor took the sounding and found the water 10 fathoms deep. How many feet deep was the water?

2. If we add $\frac{1}{8}$ of a number to itself, the sum will be how many eighths of itself? If the sum is 36, what is the number?

3. If we increase a number by $\frac{3}{5}$ of itself, the sum will be 80. What is the number?

4. A man spent $\frac{3}{5}$ of his money for a horse. How many fifths did he have left? If he had \$80 left, how much money had he at first? How much did the horse cost?

5. My brother's age diminished by 7 years equals 15 years. How old is my brother?

6. A boy spent $\frac{1}{5}$ of his money for candy and $\frac{1}{4}$ for peanuts. What part did he spend? What part had he left? If he had $44¢$ left, how much money had he at first?

7. Divide the number 42 into two such parts that one part may be five times the other part.

8. A pole increased by $\frac{1}{5}$ of its own length would be 18 ft. long. What is its length?

9. Six men can do a piece of work in 9 days. 18 men can do it in —— days. 18 men are —— times 6 men, therefore they can do the work in —— —— of the time.

10. What is the cost of 2 doz. books at $33\frac{1}{3}¢$ each?

11. At $33\frac{1}{3}¢$ each, how many books can be bought for \$9?

12. $\frac{1}{4}$ of 80 is how many times $\frac{1}{6}$ of 30?

13. Four boys contributed 30 cents each, and bought some melons at $10¢$ each. How many did they buy?

14. If 9 yd. of muslin cost \$1.50, how much will 27 yd. cost? 27 yd. are —— times 9 yd., therefore 27 yd. will cost —— times \$1.50 = \$ ——.

15. How many baskets holding 2 pk. each will 5 bu. of peaches fill?

16. 24 is 60% of what number?

17. If cloth cost \$5 a yard, how much can you buy for $\$2\frac{1}{2}$?

18. Find the interest on \$500 for 120 days.

1. A can do a piece of work in 6 days, B in 7, and C in 8. In what time can they do it working together?

2. If the diameter of my carriage wheel is $4\frac{1}{2}$ ft., how many revolutions will it make in going 2 miles and back again?

3. At \$1.85 a yard, find the cost of carpet 1 yd. wide to cover the floor of a room 22 ft. long, 19 ft. wide, if the strips run lengthwise.

4. How many 4-oz. bottles ($\frac{1}{4}$ pt.) can be filled from 4 gal. 2 qt. 1 pt. of alcohol?

5. Find the cost of 80 pieces of maple flooring, 3 in. wide, 16 ft. long, at \$38.50 per M. 100 pieces, 4 in. wide, 15 ft. long, at \$35 per M. 48 boards, 10 in. wide, 18 ft. long, at \$28.75 per M.

6. Find the interest on \$248 for 90 days at 7%.

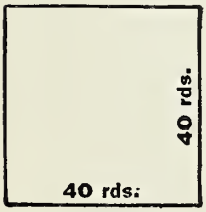
7. Find the interest on \$636 for 1 yr. 5 mo. 10 d. at 5%.

8. If a man, who earns \$90 a month, pays \$72 a month for expenses, what per cent of his money can he save?

9. A flour mill made 5280 barrels of flour in a week. $12\frac{1}{2}\%$ of it was sold to one grocer, $33\frac{1}{3}\%$ of the remainder to another, and 50% of what was then left to another. How many barrels were then left? If the remainder was sold for \$4666.20, what was the price a barrel?

10. Change $\frac{1}{4}$, $9\frac{1}{8}$, $\frac{2}{5}$, $\frac{3}{24}$, $5\frac{1}{2}$, to decimals and add.

11. What will 1200 lb. of hay cost at \$18.50 a ton?



12. If the posts are set 8 ft. apart, how many posts will be needed for the fence for this field? Find their value at \$28 per C.

13. If the fence is 5 boards high and each board is 16 ft. long, how many boards will it take for the fence?

14. If each board is 10 in. wide, find the cost of the boards at \$17 per M.

15. Find the entire cost of the fence, if the labor of making cost \$40.

1. If A man spends $\frac{3}{4}$ of his income, what per cent of his income does he spend?

2. For how much must a merchant sell goods that cost \$25, so as to gain 20%?

3. How do you find the radius of a circle when you know its circumference?

4. What two dimensions of a triangle do you need to know to find the area?

5. When these two dimensions are given, how do you find the area of a triangle?

6. How would you find the cost of the sidewalk in front of your house, if you knew the cost of a square yard?

7. State each step necessary in finding the number of yards of carpet needed to cover any room.

8. How many dimensions has a solid? Name them.

9. How many dimensions do you need to know to find the volume of a solid?

10. When you know the number of cords in a pile of wood and the width and height of the pile, how do you find the length?

11. A pile of wood is 16 ft. long, 4 ft. wide, and 4 ft. high. Can you tell how many cords there are in the pile without finding the number of cubic feet? How many cords are there?

12. A wheel is 16 ft. in circumference and made 10 revolutions in going from A to B. What can you find from this statement?

13. A wheel turns 3 times in going 45 ft. What can you find from this statement?

14. Write the table for long measure. Show how the table for square measure can be developed from the table of long measure.

15. What will 40 pt. of milk cost at 5¢ a quart?

16. \$36 is $\frac{6}{7}$ of the cost of an encyclopedia. Find the cost of 2 encylopedias at the same rate.

17. If $2\frac{1}{4}$ bbl. of apples cost \$8.10, what will 1 bbl. cost?

1. At \$3.50 a cord find the value of a pile of wood 64 ft. long, 4 ft. wide, and 6 ft. high.

2. A lady wishes to buy a carpet for a room 14 ft. long and 11 ft. wide. She has already a border of carpet 1 ft. wide all round the room. How many square yards of carpet must she buy?

3. Change 37 sq. yd. 9 sq. ft. 38 sq. in. to square inches.

4. A rug 5 yd. by 4 yd. is in the center of a room. There is a strip 18 in. wide round the room still uncovered. Find the square feet in the room. Find the square feet in the rug. Find the square feet in the part uncovered.

5. How many feet of lumber are there in 40 boards, 20 ft. long, 1 ft. 6 in. wide?

6. A merchant sold cloth at \$2.20 a yard, for which he paid \$1.88 a yard. How many yards must he sell at the same rate to gain \$19.20?

7. A wholesale grain dealer invested \$48,000 in wheat at 80¢ a bushel, 50% as much money in corn at 60¢ a bushel, and 20% as much money in oats at 50¢ a bushel. How much money did he invest in corn? How much in oats? How much in all?

8. How many bushels did he buy of wheat? How many of corn? How many of oats? How many bushels of grain did he buy?

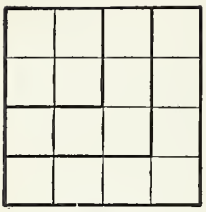
9. The minuend is 487,520, and the subtrahend is 79,026. What is the remainder?

10. At 50¢ a load find the cost of digging a cellar 27 ft. long, 18 ft. wide, and 6 ft. deep.

11. If $13\frac{1}{2}$ bu. of corn cost $\$6\frac{1}{4}$, what will $6\frac{1}{5}$ bu. cost?

12. A man divided a field containing 16 acres into lots containing 40 square rods each. How many lots were there? If the lots were sold at \$175 each, how much money was received?

13. A mill is worth \$9900, a house \$3000, and a farm $\frac{7}{12}$ of the difference between the value of the house and the mill. Find the value of all.


Scale $\frac{1}{4}$

1. From Fig. 1, show how many square inches there are in a 2-in. square. In a 3-in. square. In a 4-in. square.

2. 4 is called the *square* of 2.

3. The **square** of a number is the product obtained by multiplying the number by itself.

4. From the figure above, show the square of 3. The square of 3 is ——.

5. What is the square of 4?

6. Multiply 5 by itself. What is the result?

7. Make a drawing to illustrate the square of 6.

8. Use 7 as a factor twice. This means multiply 7 by itself. 49 is the —— of 7.

9. Square 8. This means find the square of 8. The square is ——.

10. The square of 9 is ——.

11. 10^2. This means $10 \times 10 =$ ——.

12. The little figure 2, placed at the right and above the number, is called the **exponent**. It tells us how many times 10 is to be used as a factor.

13. $12^2 =$ ——. $8^2 =$ ——. $9^2 =$ ——.

14. Find 2 equal factors of 4. Of 9. Of 16.

15. 2 is called the *square root* of 4. 3 is the *square root* of 9. What is the square root of 16?

16. The **square root** of a number is one of the 2 equal factors of the number.

17. Find the square root of 25. Of 49. Of 81.

18. Find one of the two equal factors of 36. Of 64. Of 81.

19. A square piece of paper contains 144 square inches. It measures —— in. on a side.

20. A square garden is 9 rd. on a side. It contains —— square rods.

1. Write all the perfect squares between 1 and 144.

2. Is 15 a perfect square? Name the 2 factors.

3. Find the area of a square park that is 24 rd. long.

4. There are 256 square feet in a square plot of ground. If it is 16 ft. long, how wide is it?

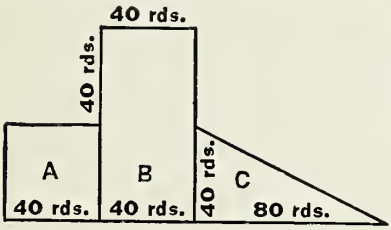
5. There are 320 square yards in a rectangular garden. If it is 16 yd. wide, how long is it?

6. How many feet of boards will be needed to roof and board the walls of a building 60½ ft. long, 40 ft. wide, and 22 ft. high to the eaves? The rafters are 23 ft. 3 in. long and the gable ends are 10 ft. high.

7. How many pickets 3 in. wide and nailed 3 in. apart will be used in fencing a lot 150 ft. by 60 ft.?

8. The triangular gable of a house has a base of 44 ft. and an altitude of 18 ft. How many square feet of boards will cover the two gables?

9. What is the perimeter of a rectangular field whose length is twice its breadth, if the breadth is 28 rd. 4 yd.?



10. This is the shape of Mr. Dexter's farm. Find the area of each of the three fields.

11. Find the area of the whole farm.

12. How does the area of A and C compare with the area of B?

13. Find the value of the farm at $80 an acre.

14. An auditorium in a public building is 40 ft. long and 36 ft. wide. Find the number of square feet in the floor and ceiling.

15. If the walls are 18 ft. high, find the square feet in the walls.

16. Find the square feet in the walls, ceiling, and floor.

1. If you buy oranges at 15¢ a dozen and sell them at 2 for 5 cents, what will be your gain per cent?

2. If a man buys a horse for $300 and sells it for $360, what per cent will he gain?

3. A boy bought some marbles for 12 cents and sold them for 15 cents. Find his gain per cent.

4. A merchant bought some muslin at 10¢ a yard and sold it at a gain of 20%. Find his gain on 25 yards.

5. A farmer had 50 sheep and bought 20% more. He then had — sheep.

6. A man spent $16\frac{2}{3}\%$ of his month's salary. If he spent $15, what was his month's salary?

What is the interest at 6% on:

7.	$200 for 2 yr.	**8.**	$300 for 4 yr.
9.	500 for 60 days.	**10.**	600 for 90 days.
11.	400 for 1 yr. 2 mo.	**12.**	800 for 1 yr. 4 mo.
13.	1000 for 2 yr. 6 mo.	**14.**	1500 for 8 mo. 6 days.

15. What is the loss per cent on goods costing 15¢ a yard if sold at 12¢ a yard?

16. What per cent of a score is a dozen?

17. What per cent of an acre is a lot 16 rd. by 5 rd.?

18. A boy earned 20¢. This was 20% of what he had before. How much had he before? How much has he now?

19. If a merchant buys goods for $5, at what price must he sell them to gain 25%?

20. An article that cost $40 was sold for $50. What was the gain per cent?

21. A man gained $12\frac{1}{2}\%$ by selling an article for $8 more than it cost him. Find the cost.

22. Can you lose more than 100% in selling an article?

23. Can a gain be greater than 100%? If so, make an example to illustrate.

In most business operations 30 days is considered a full month and the time between dates is found as in Lesson 88. For the purpose of finding interest the following method of subtracting dates is preferred as more accurate.

1. Find the interest on $396.16 from July 15, 1907, to Feb. 6, 1909.

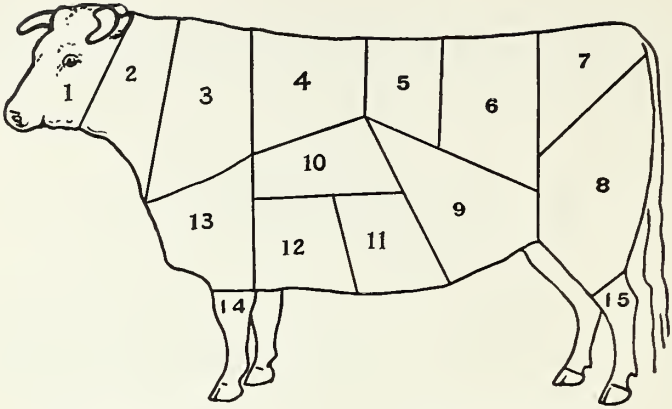
From July 15, 1907, to July 15, 1908 = 1 yr.
From July 15, 1908, to Jan. 15. 1909 = 6 mo.
From Jan. 15, 1909, to Feb. 6, 1909 = 22 d.

From a study of this solution, you will notice that we first find the full years, then the full months, then the exact days remaining. In January after the 15th there are 16 days. 16 d. + 6 d. = 22 d. As soon as possible have the pupils do the work mentally, writing only the result.

2. Perform by this method examples 8 to 13 in Lesson 88, comparing results.

Find the interest at 6% on:

3. $649.21 from June 8, 1908, to Sept. 5, 1910.
4. $1,460.78 from June 6, 1908, to April 23, 1910.
5. $284.30 from Feb. 23, 1907, to April 5, 1909.
6. $366.44 from Jan. 5, 1907, to Jan. 27, 1909.
7. $491.73 from Nov. 16, 1908, to Nov. 28, 1910.
8. $91.36 from Aug. 12, 1907, to June 10, 1911.
9. $436.74 from March 25, 1907, to June 20, 1910.
10. $589.76 from May 11, 1907, to Jan. 7, 1911.
11. $125.40 from Sept. 25, 1908, to March 16, 1910.
12. $679.08 from Feb. 10, 1907, to Dec. 7, 1909.
13. $137.65 from Oct. 14, 1908, to Dec. 29, 1911.
14. $146.35 from June 7, 1908, to Feb. 11, 1911.
15. $154.25 from April 18, 1909, to Jan. 25, 1912.
16. $817.57 from Aug. 7, 1908, to Sept. 8, 1911.
17. $132.25 from Nov. 13, 1909, to May 2, 1911.



1. Head, 6¢, 15 lb.
2. Neck, 10¢, 25 lb.
3. Chuck, 14¢, 135 lb.
4. Prime Ribs, 18¢, 60 lb.
5. Porterhouse Steak, 28¢, 80 lb
6. Sirloin Steak, 22¢, 35 lb.
7. Rump, 16¢, 30 lb.
8. Round, 18¢, 130 lb.
9. Flank, 8¢, 30 lb.
10. Short Ribs, 8¢, 25 lb.
11. Plate, 7¢, 80 lb.
12. Brisket, 10¢, 75 lb.
13. Shoulder Clod, 16¢, 60 lb.
14. Shin, 7¢, 40 lb.
15. Shank, 8¢, 22 lb.

This diagram shows the manner of cutting beef. The table gives the names of the parts and the present retail price, and the approximate weight.

1. Find the weight of this steer, and its value at retail.

2. If the live weight was 40% greater than the retail weight, and the market-man paid 8¢ live weight, find how much he paid.

3. Find his total gain if his expenses for handling were $10.

4. The following quantities of meat were used in the cooking room in one week. Find the cost for each day and for the week. Monday 6 lb. of neck for stew; Tuesday, 4½ lb. ribs for roast; Wednesday, 6 lb. rump for pot roast; Thursday, 3 lb. round for Hamburg steak; Friday, 3 lb. shin bone for stew.

5. A boarding house used the following amount of beef in a week. Find its total cost. 12½ lb. of Porterhouse steak; 24 lb. rib roast; 6½ lb. brisket for corned beef.

PICNIC LUNCH FOR 12 BOYS OR GIRLS.

Chicken Sandwiches.
Hard cooked eggs. Olives.
Bananas. Oranges.
Fudge.

Sandwiches.
Chicken 40¢.
2 loaves bread @ 10¢.
½ lb. butter @ 32¢.

1 doz. eggs @ 34¢.
2 bottles olives @ 15¢.
1 doz. bananas @ 20¢.
1 doz. oranges @ 30¢.

Fudge.
1 lb. white sugar @ 6¢.
1 lb. brown sugar @ 5¢.
½ pt. milk @ 8¢ qt.
2 oz. chocolate @ 40¢ lb.
3 oz. butter @ 32¢ lb.
Vanilla 2¢.

Note: — In the following examples, count fractions of a cent in each case as a whole cent.

1. How much does this picnic lunch cost for 12 children?

2. Find the cost for a room, containing 48 pupils.

3. Find the cost for this lunch when four rules of fudge are made and 2 times as many sandwiches.

Sponge Cake.
6 eggs @ 36¢ doz.
½ lb. sugar @ 6¢ lb.
⅜ lb. flour @ 4¢ lb.
Lemon juice 2¢.

Peanut Candy.
1 lb. sugar @ 6¢.
3 pt. peanuts @ 5¢ qt.

Peanut Cookies.
3 oz. butter @ 32¢ lb.
⅜ lb. sugar @ 6¢.
1 egg @ 36¢ doz.
Baking powder and salt 2¢.
¼ lb. flour @ 4¢.
⅛ cup ($\frac{1}{16}$ pt.) milk @ 8¢ qt.
1 pt. peanuts @ 5¢. qt.

At a sale some girls made 10 rules of fudge, each rule weighing 2 lb., and 12 rules of peanut candy, each weighing 1½ lb. Other girls made 6 rules of peanut cookies, each rule making 2 doz. cookies, and others made 10 loaves of sponge cake.

4. Find the total cost of this material.

5. Find the total received when sold at the following prices: Candy 40¢ a pound, cookies 18¢ a dozen, and cake 30¢ a loaf.

BREAKFAST FOR FOUR PERSONS.

Oranges.	Wheatena with Dates.
Cocoa.	Toast.

1. Find the entire cost of the breakfast, if the following materials were used: counting fractions of a cent in each case as a whole cent.

2 oranges @ 30¢ doz.
4 oz. sugar @ 6¢ lb.
2 oz. dates @ 10¢ lb.
⅔ loaf bread @ 5¢.
⅕ pkg. Wheatena @ 24¢.
1½ qt. milk @ 7¢.
⅛ can cocoa @ 24¢.
2 oz. butter @ 32¢ lb.

DINNER FOR SIX PERSONS.

Cream of Tomato Soup.
Hamburg Steak.
Baked potatoes. Macaroni and cheese.
Bread. Butter.
Custard Pudding.

Cream of Tomato Soup.

1 can tomatoes @ 15¢.
4 oz. butter @ 32¢ lb.
1 oz. flour @ 4¢ lb.
Salt, pepper, and soda 2¢.
1 qt. milk @ 7¢.

Macaroni and Cheese.

⅓ pkg. macaroni @ 15¢.
4 oz. butter @ 32¢ lb.
1 oz. flour @ 4¢ lb.
Salt and pepper, 1½¢.
1 cup milk @ 8¢ qt.
¼ lb. cheese @ 20¢ lb.
¼ loaf bread @ 5¢.

Custard Pudding.

⅙ lb. rice @ 10¢.
2 cups (1 pt.) milk @ 8¢ qt.
2 eggs @ 36¢ doz.
⅛ lb. sugar @ 6¢.
Vanilla and salt 3¢.

2 lb. steak @ 16¢.
1 qt. potatoes @ 32¢ pk.
Fuel 5¢.

2. Find the total cost of the dinner, and the average for each person. Count fractions of a cent in each case as a whole cent.

3. How much would the cost be reduced if the soup was omitted?

4. How much more would this dinner have cost the family, if bought at a restaurant at 35¢ each?

If 16 cd. of wood cost \$96, what will 25 cd. cost?

a. Read the problem carefully, noting what is given; thus, I know that 16 cd. cost \$96.

b. Read the problem again, noting what is required; thus, I am asked to find the cost of 25 cd.

c. What do I need to know before I can find what is required?

d. Plan the solution, thus: $\frac{\$96}{16} \times 25 = \$ \text{——}$.

e. Ask, "Is the result reasonable?" Thus 25 cd. is a little more than $1\frac{1}{2}$ times 16 cd. The result must be a little more than $1\frac{1}{2}$ times \$96. Is it?

NOTE: — Notice what you are to discover each time you read the problem. In many problems the answer to *c* will be nothing, as you can find directly what is required from what is given. Plan the complete solution in advance and use cancelation when possible. Always take the fifth step. By estimating the answer either in advance or at the end of the work you will avoid nonsensical answers and find many errors. This will tend to make you more accurate, which is so essential in arithmetic.

Solve the following problems by this method:

1. If 7 tons of coal cost \$35, what will 4 tons cost?

2. If a bushel of beans weighs 60 lb. and a barrel holds 3 bu., how many barrels will it take to hold 5 tons?

3. My sister Alice hires a bicycle for 30¢ an hour. What must she pay for its use from 10 A.M. to 3.30 P.M.?

4. I hired 4 men to work at \$3 a day each. The first worked $\frac{1}{2}$ day, the second $\frac{5}{6}$ of a day, the third $2\frac{1}{4}$ days, and the fourth $1\frac{1}{5}$ days. How much must I pay each of them?

5. If 3 bbl. of oil cost \$15.75, what will $18\frac{1}{5}$ bbl. cost?

6. If I buy a barrel of oil containing 42 gal. for \$3.50 and retail it at $12\frac{1}{2}$¢ a gallon, how much do I make?

7. My house cost me \$5000, and I pay \$16 on each thousand as a tax. If I rent the house for \$30 a month, how much more than the tax shall I receive?

1. The cost of running a revenue cutter for one year was as follows: Salaries, $14,492.08; provisions, $1,913.77; coal, $6,446.80; repairs, $1,608.54; other expenses, $2,038.42. Find the total cost.

2. If this cutter used 246 tons of coal in 2 mo., how many tons did she use in a year? What price was paid a ton?

3. If the cutter cruised during the year 11,244 miles, what was the average number of miles a month?

4. Divide the total cost of running the cutter by the number of miles sailed. Find to the nearest dollar the cost for each mile.

5. Mr. S. has 62½ acres of land in tobacco in the Philippines. He set out 4000 plants to the acre. If each plant produced 20 leaves, how many bales of 4000 leaves each did he raise?

6. How many pounds did he raise if each bale weighed 21 pounds?

7. He sold 17,600 lb. @ 16¢, and 8360 lb. @ 21¢. What did he receive for his tobacco?

8. Mr. S. has also a sugar plantation, which contains 30 acres. If it yields 600 lb. to the acre, how many tons of sugar will the plantation yield?

9. If he sold his crop at $2.10 for every hundred pounds, how much did he receive?

10. Mr. S.'s expenses were as follows: 4 sacks of rice @ $2, 8 workmen @ $20 each, ploughing $30, hauling cane $15, feed of oxen $20, provisions $50, repairs $100, grinding cane $176. Find the total expenses.

11. How much less did he receive for his sugar than his total expenses amounted to?

12. Mr. S. has also a coconut grove of 7½ acres. There are 180 trees on each acre and an average of 90 coconuts on each tree. How many coconuts does the grove produce?

13. The coconuts sell on the tree at 55¢ a hundred. How much will Mr. S. receive from his coconut grove?

1. A Minnesota farmer raised 420 acres of wheat last year, which yielded 15 bu. of wheat per acre. How many bushels did he raise?

2. His expenses an acre for raising and harvesting his wheat were as follows: Ploughing 80¢, seed wheat ($1\frac{1}{2}$ bushels) @ 90¢, sowing 70¢, harvesting $1.80, marketing $1.40. Find the total expenses for the field.

3. Find his total gain, if he sold his crop at 80¢ a bushel.

4. One of the Minneapolis flour mills makes 1200 barrels of flour a day. If it takes $4\frac{1}{2}$ bu. of wheat for each barrel, how many bushels do they grind each day?

5. How long would the farm of 420 acres supply the mill with wheat for grinding? How many such farms would be necessary to keep the mill running constantly for 300 days?

6. A bushel of wheat weighs 60 pounds. How many pounds of wheat are ground to make 1 barrel (196 lb.) of flour?

7. Besides the flour the $4\frac{1}{2}$ bu. of wheat produce 25 lb. of shorts, 47 lb. bran, and 2 lb. of waste. Find the total amount of flour, shorts, and bran produced from the wheat on the above farm.

8. The milling company sold the bran at $14 a ton, the shorts at $16 a ton, and the flour at $4.50 a barrel. Find the total receipts for a week.

9. If the company paid $.90 a bushel for the wheat, and $450 a week for expenses, find their total gain for the week.

10. At the same gain a week find the total gain to the milling company for 1 year of 52 weeks.

11. Compare the annual profit of the farmer who raised 420 acres of wheat with that of the mill company. Compare also the amount of wheat handled by the farmer and by the mill company.

12. The 7 flour mills in Minneapolis produce daily 85,673 barrels of flour. Find the number of bushels of wheat used annually in these flour mills.



1. How does a compare in length with b? How does b compare with a?

2. In the same way compare a with each of the other lines and each of the other lines with a.



3. Compare the area of each figure with each of the other figures.

4. The **comparison** of one object or quantity with another object or quantity of the same kind is called **ratio.**

5. Ratio is really the quotient obtained by dividing one number by another, and is expressed in three ways:

a. By the sign of division, as $12 \div 3$.

b. By the colon, as 12 : 4, read 12 *is to* 4.

c. By a fraction $\frac{12}{4}$.

6. Draw a line 2 in. long. How long will another line be if its ratio to the first line is 4? 6? $\frac{1}{4}$? $\frac{1}{2}$?

7. 3 is the ratio of 6 to ——. $\frac{1}{2}$ is the ratio of 6 to ——.

8. Draw an inch square. Draw an oblong 4 times as long and $\frac{1}{2}$ as wide. What is the ratio of the lengths? Of the widths? Of the areas?

9. Express the relation that 6 bears to 9. Express the relation that 9 bears to 6.

10. What is the ratio of 2 to 6? 8 to 4?

1. Ratio is found by dividing the first number by the second.
2. The first term of a ratio is called the **antecedent.**
3. The second term of a ratio is called the **consequent.**

What is the ratio of:

4. 42 to 6?
5. 8 to 56?
6. \$4 to 50 ct.?
7. 1 d. to 2 hr.?
8. 4 mo. to 1 yr.
9. 2 wk. to 2 d.?
10. 1 ft. to 1 yd.?
11. 2 min. to 30 sec.?
12. 4 oz. to 1 lb.?

13. Separate \$35 in the ratio of 2 to 3.

$\frac{2}{5}$ of \$35 = \$14.
$\frac{3}{5}$ of \$35 = \$21.

There must be \$2 in the first part to every \$3 in the second, and there must be \$5 each time both amounts are taken out. Therefore, the first part must contain $\frac{2}{5}$ of the total, and the second $\frac{3}{5}$ of the total.

14. A and B together own 824 sheep. The ratio of A's sheep to B's is as 5 to 3. How many sheep has each?

15. How long will it take 5 men to do a piece of work that can be done by 15 men in 9 days? What is the ratio of 15 men to 5 men?

16. Divide \$192 between 2 men in the ratio of 13 to 3.

17. Separate 260 in the ratio of 9 to 3.

Find the ratio of:

18. 1.25 : 37.5
19. $2\frac{1}{5} : 3\frac{1}{3}$
20. 2 m. : 640 ft.
21. 6.25 : 2.5
22. $5\frac{3}{4} : 6\frac{1}{2}$
23. 5 wk. : $4\frac{1}{2}$ d.

24. Two men rent a pasture for \$104. One puts in 6 cows and the other 2. How much rent should each pay?

25. A man's income is \$1400 a year. If the ratio of his expenses to his savings is as 2 to 5, find the amount of his savings.

26. The ratio of the circumference of a circle to its diameter is $3\frac{1}{7}$. What is the circumference of a circle whose diameter is 14 ft.?

27. The ratio of the length of a rectangle to its breadth is 3 to 4. If the perimeter is 56 ft., find the length and the breadth.

1. What is the ratio of 8 to 4? What is the ratio of 6 to 3?

2. These two ratios, being equal, may be written $8:4 = 6:3$. These *two ratios* make a *proportion.*

3. **Proportion** is an expression of an *equality of ratios.* A proportion may be read in this way: The ratio of 8 to 4 equals the ratio of 6 to 3, or 8 is to 4 as 6 is to 3.

4. In the proportion $8:4 = 6:3$, how many ratios are there? Name the antecedent of each ratio. Name the consequent of each ratio.

5. In every proportion the first and fourth terms are called the **extremes**, the second and third terms the **means**. Together they are called the **terms** of the proportion.

6. Name the extremes and means in the proportion in example 4.

7. Multiply the extremes together. Multiply the means together. Compare the two products.

Learn: In every proportion the product of the means equals the product of the extremes.

8. Since this is true, if any three terms of a proportion are given, the other can be found.

9. Either extreme equals the product of the means divided by the other extreme, as $x:4 = 6:3$. $3x = 24$. $x = 8$.

10. Either mean equals the product of the extremes divided by the other means, as $8:x = 6:3$. $6x = 24$. $x = 4$.

Find the missing terms in the following proportions:

11. $4:6 = 8:x$
12. $x:8 = 10:40$
13. $9:x = 7:21$
14. $6:3 = x:11$
15. $8:4 = 12:x$
16. $x:5 = 8:20$
17. $9:5 = x:15$
18. $8:x = 6:12$
19. $10:6 = 6:x$
20. $x:8 = 7:3$
21. $\frac{5}{6}:x = \frac{1}{3}:\frac{1}{5}$
22. $x:\frac{3}{8} = \frac{1}{9}:\frac{1}{3}$

1. If 6 tons of coal cost \$28, how many tons can be bought for \$84?

\$28 : \$84 = 6 tons : x tons

$$\frac{\overset{3}{\cancel{84}} \times 6}{\underset{}{\cancel{28}}} = 18 \text{ tons.}$$

Let x = the tons that can be bought, and write the ratio 6 tons: x tons. Since the cost of coal is directly proportional to the quantity, we write our first ratio, \$28 (the cost of 6 tons): \$84 (the cost of x tons). Our proportion is \$28: \$84 = 6 tons: x tons. In solving use cancelation.

2. The following are usually directly proportional:

a. Cost of goods to the quantity.
b. Weight to volume.
c. Income to time of labor and to capital.
d. Distance to time.

3. If 6 men can build a wall in 24 days, how long will it take 18 men to build it?

18 men : 6 men = 24 d. : x d.

$$\frac{6 \times \overset{8}{\cancel{24}}}{\underset{3}{\cancel{18}}} = 8$$

Let x = the number of days. Write the ratio 24 d.: x d. Since time required is inversely proportional to the number of workmen, we write 18 men (the number for x days): 6 men (the number for 24 days). Canceling we have 8 days.

4. Before beginning work carefully decide whether the numbers are *directly* proportional or *inversely* proportional.

5. If a man earns \$48 in 4 mo., how much will he earn in 9 mo.?

6. What will 6 tons of coal cost, if 9 tons cost \$54?

7. If 12 men can do a piece of work in 6 days, in how many days can 8 men do it?

8. If 54 bu. of wheat make 12 bbl. of flour, how many barrels of flour will 108 bu. make?

9. If 45 sheep cost \$270, what will 165 sheep cost?

10. If 35 acres of land cost \$937.50, what will 175 acres cost?

11. If 15 yd. of cloth cost \$24, what will 65 yd. cost?

We may write any proportion so that the unknown number will come in any term we wish. We have learned that the result may easily be found. For those who prefer the following method of arranging the ratios is given.

1. A family of 6 persons pays \$21 a week for board. At the same rate what must a family of 8 persons pay?

$6 : 8 = \$21 : \$x$

$$\frac{\overset{4}{\cancel{8}} \times \overset{7}{21}}{\underset{3}{\cancel{6}}} = \$28.$$

Since we are seeking for cost, we place \$21 in the third place, because the third and fourth terms form a ratio and must be of the same kind. We know that 6 persons pay \$21, then 8 persons will pay *more* dollars. This shows us that the consequent of our second ratio will be larger than its antecedent, therefore, to have an equality of ratios we must make the consequent of our first ratio larger than its antecedent. The proportion must be $6 : 8 = \$21 : \$x$.

2. If $\frac{5}{9}$ of a store is worth \$5200, how much is $\frac{7}{8}$ of it worth?

$\frac{5}{9} : \frac{7}{8} = \$5200 : \$x.$

$$\frac{\$5200 \times \frac{7}{8}}{\frac{5}{9}} = \$5200 \times \tfrac{7}{8} \times \tfrac{9}{5} = \$ \text{——}.$$

Arrange as indicated for cancelation. Remember the rule for dividing by a fraction.

3. If $3\frac{1}{2}$ yd. of velvet cost $\$5\frac{1}{4}$, how much will $7\frac{1}{2}$ yd. cost?

4. If $4\frac{1}{2}$ lb. of butter cost \$1.35, what will $17\frac{1}{4}$ lb. cost?

5. If $\frac{7}{8}$ of a yard of silk cost \$2.10, what will $33\frac{1}{3}$ yd. cost?

6. If $\frac{7}{9}$ of a yard cost $\$1\frac{2}{5}$, what will $\frac{3}{4}$ of a yard cost?

7. If 9 weeks' board cost $\$94\frac{1}{2}$, what will 12 weeks' board cost?

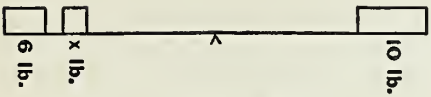
8. If a loaf of bread weighs 8 oz., when flour is worth \$5 a barrel, what should it weigh when flour is worth \$6 a barrel?

9. If 25 men can do a piece of work in 12 days, in how many days can 10 men do the same work?

10. If 24 men can build a house in 15 days, how many men will it take to build it in 24 days?

11. A tree 18 ft. high casts a shadow 45 ft. long, how high must a steeple be to cast a shadow 135 ft.?

12. If $\frac{5}{9}$ of a farm is worth \$4500, what is $\frac{3}{4}$ of it worth?



6 lb. + x lb. = 10 lb.

1. How heavy must the x weight be that the two weights may balance the 10-lb. weight?

2. This may be written $x + 6 = 10$. When written in this form it is called an **equation.** $x + 6$ is the **first member** and 10 is the **second member.**

3. If I should take off the 6-lb. weight what would happen? What must I take off from the other side to restore the balance or equality?

4. Suppose I place a 5-lb. weight with the 10-lb. weight, what would happen? How could I restore the equality?

Learn: The same number may be added to or subtracted from both members of an equation without changing the equality.

5.
$$\begin{aligned} x + 6 &= 10 \\ 6 &= 6 \\ \hline x &= 4 \end{aligned}$$

In this equation 6 has been added to x. We must then subtract 6 from both members to find the value of x.

6.
$$\begin{aligned} x - 5 &= 12 \\ 5 &= 5 \\ \hline x &= 17 \end{aligned}$$

In this equation 5 has been subtracted from x. We must then add 5 to both members to find the value of x.

Find the value of x in the following:

7. $x - 4 = 6$	**8.** $x + 6 = 14$	**9.** $x - 7 = 4$
10. $5x + 2 = 12$	**11.** $2x + 6 = 8$	**12.** $4x + 5 = 13$
13. $3x - 7 = 11$	**14.** $2x - 9 = 21$	**15.** $2x - 5 = 7$

16. The difference between two numbers is 6, and their sum is 40. Find the numbers.

Let x = the smaller number.
then $x + 6$ = the larger number.
Then $2x + 6 = 40$

$$\begin{aligned} 6 &= 6 \\ \hline 2x &= 34 \\ x &= 17 \text{ the smaller number.} \\ x + 6 &= 23 \text{ the larger number.} \end{aligned}$$

A knowledge of the equation will be found very useful in solving problems. Study the solution and see if you see where the equation, $2x + 6 = 40$, comes from.

1. $3x = 9$. Divide both members of the equation by 3.
   $x = 3$.
2. $\frac{1}{2}x = 5$. Multiply both members of the equation by 2.
   $x = 10$.

Learn: We may multiply or divide both members of the equation by the same number and not destroy the equality.

State what must be done to both members to find the value of x:

3. $7x = 21$	4. $3x = 18$	5. $2x = 10$
6. $\frac{1}{2}x = 4$	7. $\frac{1}{3}x = 5$	8. $\frac{1}{4}x = 6$
9. $6x = 24$	10. $9x = 45$	11. $5x = 25$
12. $\frac{1}{5}x = 6$	13. $\frac{1}{6}x = 3$	14. $\frac{1}{3}x = 2$

15. If $\frac{3}{4}$ of the number of pupils in school is 36, how many pupils are there?

Let x = the number.
Then $\frac{3}{4}x = 36$.
$3x = 144$
$x = 48$

Multiply both sides of the equation $\frac{3}{4}x = 36$ by 4. $\frac{3}{4}x \times 4 = \frac{12x}{4} = 3x$. $36 \times 4 = 144$. Then $3x = 144$.

16. $\frac{2}{5}$ of a number increased by $\frac{1}{2}$ of the number equals 27. Find the number.

Let x = the number.
Then $\frac{2x}{5} = \frac{2}{5}$ of the number.
and $\frac{1}{2}x = \frac{1}{2}$ of the number.
$\therefore \frac{2x}{5} + \frac{1}{2}x = 27$.
$4x + 5x = 270$
$9x = 270$
$x = 30$

Multiply the equation $\frac{2x}{5} + \frac{1x}{2} = 27$ by 10 (the common denominator of $\frac{2}{5}$ and $\frac{1}{2}$). $\frac{2x}{5} \times 10 = \frac{20x}{5} = 4x$. $\frac{1x}{2} \times 10 = \frac{10x}{2} = 5x$. $27 \times 10 = 270$. Hence $4x + 5x = 270$.

Each problem requires its own statement or equation. While each differs from any other, a careful study of the illustrative problems in the preceding pages should give you an idea of the method of procedure.

1. From a box containing oranges, $\frac{1}{3}$ were sold. If 82 then remained, how many were there at first?

2. Four-sevenths of a number is 18 less than the number itself. Find the number.

3. A number diminished by $\frac{5}{13}$ of itself is 7296. What is the number?

4. A horse and carriage are worth \$763. If the carriage is worth $\frac{2}{5}$ as much as the horse, what is the value of each?

5. Divide 75 apples between Richard and Henry so that Richard may have 15 apples more than Henry.

6. What number added to 3 times itself gives 64?

7. A and B together have \$450. If A has $\frac{2}{3}$ as much as B, how many dollars has each?

8. Mary and Nellie have 80 apples. Mary has $\frac{3}{5}$ as many as Nellie. How many has each?

9. An estate was divided among 3 children, so that one received $\frac{2}{7}$ of it, the second $\frac{2}{5}$ of it, and the third \$4840. Find the value of the estate.

10. A owns $\frac{2}{7}$ of a store, B $\frac{2}{9}$ of it, and C the remainder, or \$31,000. What is the value of the estate?

11. A owns $\frac{2}{7}$ of a store and B the remainder. If B owns \$465 more than A, what is the value of the store and of each one's share?

12. If a certain number diminished by $\frac{1}{4}$ of itself is 105, what is the number?

13. Separate \$182 in the ratio of 3 to 4.

Let $3x$ = one part.
and $4x$ = other part.
Then $7x$ = \$182
x = \$ 26 $3x$ = \$78 $4x$ = \$104.

14. Divide \$416 between A and B, giving A \$5 as often as you give B \$3.

1. A can do $\frac{1}{3}$ of a piece of work in 4 days and B can do the whole of it in 8 days. In how many days can both do it working together?

2. A horse was sold at a loss of $16\frac{2}{3}\%$ and \$16 was lost. Find the selling price.

3. A rectangular piece of paper containing 6 sq. ft. is 9 in. wide. How long is it?

4. A house and lot cost \$9800. If the house cost 4 times as much as the lot, find the cost of each.

5. A starts from New York and travels 8 miles an hour, and 6 hours afterwards B starts from the same place and follows at the rate of 10 miles an hour. At what distance from New York will B overtake A?

6. The area of a rectangular field is 12 acres. If its length is 20 rd., what is its width?

7. In digging a trench 3 ft. wide and $4\frac{1}{2}$ ft. deep, 330 cu. yd. of earth were removed. How long was the trench?

8. At \$3 a cord find the cost of a pile of wood 24 ft. long, 4 ft. wide, and $7\frac{1}{2}$ ft. high.

9. A button is 4.7124 in. in circumference. How long a buttonhole is needed?

10. A hogshead is $12\frac{1}{2}$ ft. in circumference. Can it pass through a door 3 ft. 9 in. wide?

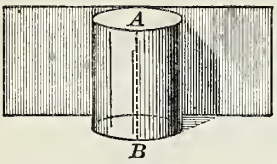
11. If $8\frac{3}{4}$ tons of coal cost $\$43\frac{3}{4}$, how many tons can be bought for $\$127\frac{1}{2}$?

12. A farmer raised 2146 bbl. of apples. He sold $\frac{2}{5}$ of them at $\$1\frac{3}{4}$ a barrel and the remainder at $\$2\frac{1}{2}$ a barrel. How much did he receive for all?

13. How many board feet are there in 12 planks, 21 ft. long, 18 in. wide, and $2\frac{1}{2}$ in. thick?

14. Find the amount of \$161.60 for 2 yr. 9 mo. 3 d. at $4\frac{1}{2}\%$.

15. If a reservoir is 30 ft. 6 in. long and 20 ft. 6 in. wide, how many cubic feet of water must be removed to lower the water $1\frac{1}{2}$ ft.?



1. Make a paper cylinder and cut it on the line AB, as in the figure.

2. After cutting, open to a flat surface, what form have you?

3. The length and height of the rectangle were what dimensions of the cylinder?

4. The curved surface of a cylinder is called its **convex surface.**

Learn: To find the convex surface of a cylinder, multiply its circumference by its height.

5. The ends of a cylinder have what form?

6. To find the entire surface of a cylinder, what must be added to the convex surface?

7. Repeat the rule for finding the area of a circle.

Find the entire surface of cylinders having the following dimensions, calling π $3\frac{1}{7}$.

8. Circumference 44 ft., height 20 ft.

9. Circumference 22 ft., height 42 ft.

10. Circumference 66 ft., height 30 ft.

11. Diameter 14 in., height 2 ft.

12. Diameter 21 in., height 48 in.

13. Diameter 7 ft., height 15 ft.

14. Find the convex surface of a cylinder 40 ft. long, and 15 ft. in diameter, using π as 3.1416.

15. How many square feet of surface are there in a stove pipe 16 ft. long and 7 in. in diameter?

16. At 19¢ a square yard, what will it cost to paint the outside and the inside of a cylindrical tank 9 ft. long and 7 ft. in diameter, no attention being paid to thickness of material?

17. At 5¢ a square foot find the cost of covering the rolling (convex) surface of a roller $7\frac{1}{2}$ ft. long and $3\frac{1}{2}$ ft. in diameter.

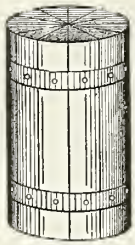


FIG. 1.

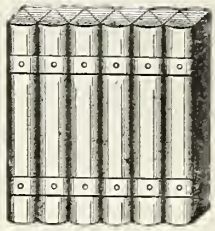


FIG. 2.

NOTE: — These drawings were made from a cylinder cut into sections as indicated. Fig. 2 represents a prism made by placing the sections of Fig. 1 as the parts of the circle were placed in Lesson 50.

1. How do you find the contents of a prism?

2. The length, width, and height of the prism were what dimensions of the cylinder?

3. Finding the area of one end of the prism is the same as finding the area of what in the cylinder?

Learn: To find the contents of a cylinder multiply the number of cubic units that can be placed in one layer on the base, by the number of layers. This is usually briefly stated thus: Multiply the area of the base by the height.

Using $\pi = 3.1416$, *find the volume of cylinders having the following dimensions:*

4. Altitude 8 ft. 6 in., diameter 3 ft.

5. Altitude 15 ft., radius 1 ft. 3 in.

6. Altitude 7 ft. 4 in., diameter 5 ft.

7. How many gallons approximately will a circular cistern hold that is 9 ft. deep and 3 ft. in diameter?

8. At 32¢ a cubic foot what is the value of a log 45 ft. long and 2 ft. in diameter?

9. A water pipe measures 3 ft. in diameter and 18 ft. in length. Approximately, how many gallons will it hold?

10. Find the volume of a cylinder whose circumference is 15 ft. and altitude 27 ft.

1. The average yield of cotton per acre is 250 lb. The average weight of a bale is 500 lb. How many bales will a plantation of 600 acres produce?

2. The market quotation of cotton to-day is $12\frac{1}{2}¢$ a pound. Find the value of the cotton on this plantation.

3. Should the price of cotton drop to $8¢$, what per cent would the owner of this plantation lose? How much money would he lose?

4. A cotton mill in Alabama uses 15 bales a day. How many acres will it take to keep the mill running 300 days in a year?

5. How many days will the 600-acre plantation keep the Alabama mill supplied with cotton?

6. A mill in Fall River uses 115 bales a day. At $12\frac{1}{2}¢$ a pound find the cost of the cotton used in this mill in 300 days.

7. It is estimated that the average consumptiom of sugar is 70 lb. for every person. Find in your geography the population of the United States and estimate the quantity consumed.

8. If the United States produces 372,000 tons annually, how much must we import?

9. At $5¢$ a pound find the value of the sugar we import and the value of the quantity we produce.

10. The anthracite coal beds in Pennsylvania were estimated to contain 19,500,000,000 tons of coal. If 40% of this cannot be mined, how many tons can be mined?

11. If 3,900,000,000 tons have already been mined, what per cent of the total coal output has been taken out? How many tons still remain to mine?

12. 10,000,000,000 ft. of lumber are cut in the Southern States every year. Find the value at $16 per M.

13. In the Dakotas the farmers sowed 4,882,157 acres to wheat. The average yield was 18 bu. to an acre. Find the value of their wheat crop at $75¢$ a bushel.

14. If 6 pk. of seed were sown per acre, find the cost at $80¢$ a bushel of seed used on the Dakota wheat fields.

1. The selling price of a cow is \$60. The gain in selling is 25%. What two things can be found? Find them.

2. A can do a piece of work in 4 days, B can do it in 5 days. In what time can A and B do it if they work together?

3. A rectangular field contains 1 acre. If it is 80 rd. long, how wide is it? What is its perimeter?

4. How many 2-in. cubes can be cut from a 10-in. cube?

5. How many cows at \$25 a head can be bought for \$500?

6. A man bought a gallon of milk for 28¢ and sold it at 4¢ a pint. How much did he gain on a quart?

7. What part of a dollar did I pay for $6\frac{1}{4}$ lb. of candy at 12¢ a pound?

8. I sold my watch for \$18, which was $12\frac{1}{2}\%$ more than it cost me. Find the cost.

9. What is the interest on \$2468 for 30 days at 6%?

10. Divide \$100 between A and B, giving A \$6 as often as you give B \$4.

11. If a man can walk $3\frac{1}{4}$ miles in 2 hours, how far can he walk in 8 hours?

12. If 4 men can do a piece of work in 6 days, how long will it take 12 men to do the same work?

13. What per cent of a number is $\frac{5}{8}$ of it?

14. What will 2 doz. knives cost at $33\frac{1}{3}$¢ each?

15. An article was bought for \$80 and sold at 25% profit. What two things can you find? Find them.

16. If a book agent received \$50 for selling \$150 worth of books, what was his rate of commission?

17. An auctioneer sold \$500 worth of goods at a commission of 4%. What was his commission?

18. An article that cost \$4.50 was sold for \$6. What two things can you find? Find them.

19. If a boy lost $\frac{3}{5}$ of his money and had 8 cents left, how much had he at first?

1. The difference between two numbers is 2,001,005. The larger number is 89,009,089. Find the smaller number.

2. The quotient is 4769. What would the quotient be, if the dividend was multiplied by 9?

3. The quotient is 4664. What would the quotient be if the divisor was multiplied by 8?

4. The quotient is 805. What would the quotient be if the divisor was $\frac{1}{6}$ of what it is now?

5. The quotient is 909. What would the quotient be if both dividend and divisor were multiplied by 15?

6. The quotient is 478. What would the quotient be if both divisor and dividend were divided by 12?

7. If the divisor was 8 times larger than it is, the quotient would be 489. What is the quotient?

8. What number must be taken from 7684 that it may be exactly divisible by 33?

9. If 37 is added 99 times to itself the result will be how much less than 3750?

10. If 37 is added to a certain number, 85 can be subtracted from it 113 times. Find the number.

11. Of what number might 463 be both divisor and quotient?

12. If 593 is subtracted 347 times from a certain number the remainder is 287. Find the number.

13. Multiply 60.325 by 7.0034 and divide the product by 3.01625.

14. What name would you give to a figure that has 4 equal sides and 4 right angles?

15. What decimal is as much smaller than .5275 as .5275 is smaller than .74?

16. The subtrahend is 6.9×3.04. The minuend is 26.08×1.002. What is the difference?

17. Add: 243 thousandths, 203 ten-thousandths, 546 millionths, 12 and 1234 hundred-thousandths, 116 ten-millionths

1. A man paid \$105 for a carriage and $\frac{5}{7}$ as much for a sleigh. How much did both cost?

2. $\frac{6}{7}$ of 84 are how many times $\frac{3}{4}$ of 24?

3. If $5\frac{1}{2}$ lb. of sugar cost $44¢$, how much will $2\frac{1}{2}$ lb. cost?

4. Reduce $\frac{1}{2}$, $\frac{2}{3}$, and $\frac{3}{5}$ to a common denominator.

5. Reduce $\frac{28}{40}$ and $\frac{35}{60}$ to their lowest terms.

6. Dick gave $\frac{2}{3}$ of his money for peanuts and $\frac{1}{3}$ for candy. What part of his money did he spend?

7. $\frac{1}{3}$ of a number increased by $\frac{1}{5}$ of it is 32. What is the number?

8. A man had 6 times $\$6\frac{1}{6}$, and needed \$4 more to buy a cow. Find the cost of the cow.

9. 4 times $2\frac{1}{3}$ miles is $\frac{1}{3}$ of the distance between two cities. How far apart are the cities?

10. If 4 men can do a piece of work in 3 days, in how many days can they do a piece of work 6 times as large?

11. What per cent of a yard is 2 ft.?

12. If $\frac{6}{7}$ of a yard of cloth cost 30 cents, how much will $\frac{3}{5}$ of a yard cost?

13. If 3 bags of meal cost $\$3\frac{3}{4}$, how many bags can I buy for \$2.50?

14. Two travelers start at the same time toward each other from cities 60 miles apart. A travels 7 miles an hour and B 8 miles. In how many hours will they meet? How far will each have traveled?

15. A and B can do a piece of work in 5 days. A can do it alone in 10 days. In what time can B do it alone?

16. The circumference of a cylinder is 16 in. If it is 6 in. high, what is its convex surface?

17. The area of one end of a cylinder is 12 sq. in. If it is 10 in. high, how many cubic inches does it contain?

18. A rectangular prism contains 72 cu. in. It is 6 in. long and 4 in. wide. How thick is it?

1. Find the cost of carpet 27 in. wide at \$1.25 a yard for a room 18 ft. by 14 ft., if the strips run lengthwise.

2. How many board feet are there in twelve 4-in. planks 16 ft. long and 10 in. wide?

3. What will it cost to build a wall 90 ft. long, $7\frac{1}{2}$ ft. high, and 2 ft. thick at \$6 a cubic yard?

4. Find the number of bushels of grain in a bin that is $6' \times 5' \times 4'$. 1 bu. $= 1\frac{1}{4}$ cu. ft.

5. Find the number of gallons of water that can be put in a circular cistern 21 ft. in diameter and 10 ft. deep. There are $7\frac{1}{2}$ gal. in a cubic foot.

6. At \$4.75 a ton what is the cost of 563,800 lb. of coal?

7. How many square feet of tin will be required for making 800 rectangular cans $8'' \times 6'' \times 12''$, adding 6 sq. in. for waste in making each can?

8. Find the interest on \$1250 from Nov. 15, 1909, to March 1, 1911, at 5%.

9. A and B can build a wall in 10 days. A can build it in 18 days. How long will it take B to build it alone?

10. A pile of wood contains 200 cords. It is 4 ft. wide and 8 ft. high. How long is it?

11. If a man buys \$800 worth of goods at a discount of 25%, what will be the discount? What will the goods cost the man?

12. An agent sold a farm for \$7600. His commission was $2\frac{1}{2}$%. Find the commission. Find the amount that the owner received for the farm.

13. An agent bought for me 8000 lb. of butter at 30¢ a pound. If his commission is 3%, how much money must I send him?

14. A grocer bought 160 barrels of potatoes @ \$1.60 a barrel. 10% of them spoiled and he sold the remainder at \$1.90 a barrel. How much did he gain?

15. If an acre of ground costs \$240, what is the value of a rectangular lot 12 rd. long and 165 ft. wide?

1. Land which cost \$5600 was sold at a profit of 25%.

2. 17 gal. 3 qt. 1 pt. of molasses were sold from a cask containing 25 gal. 2 qt.

3. In a school the girls are 52% of the whole number, and there are 240 boys.

4. A granite step measures $\frac{2}{3}' \times 2' \times 8'$. A cubic foot of granite weighs 170 lb.

5. The circumference of the driving wheel of a locomotive is 22 ft. In going from A to B the wheel turned 9600 times.

6. A farmer raised 45 acres of oats, averaging 25 bu. to an acre. The price of oats was 52¢ a bushel.

7. A cistern of water was $\frac{4}{5}$ full. $\frac{1}{2}$ of the contents of the cistern was drawn off at one time and $\frac{1}{3}$ of the remainder at another time.

8. A man bought a house for \$2160. The house cost him $\frac{3}{5}$ as much as he paid for a mill.

9. A steamboat runs 144 knots in 6 hours. It takes 36 hours for the steamboat to run a certain distance.

10. It is 137 miles from Portland to Bangor. A man walks about 3.5 miles an hour.

11. A bicycle tire is 28 in. in diameter. A boy rode $\frac{1}{2}$ mile.

12. A clerk earned \$15 a week for 14 calendar months.

13. A man owned 16 A. of land. He sold 1280 square rods.

14. A grocer paid \$3.78 for a barrel of vinegar ($31\frac{1}{2}$ gal.) and sold it at 5¢ a quart.

15. On March 1, 1909, the sun rose at 6 hr. 36 min. A.M., and set 5 hr. 50 min P.M. On July 1, it rose at 26 min. past 4 o'clock and set at 40 min. past 7 o'clock.

16. A man borrowed \$250 at 5%. He returned it in 2 yr. 4 mo. 20 d.

17. The living expenses of a family are \$65 a month.

18. A bin, 12 ft. long, 4 ft. wide, and 3 ft. deep, is full of potatoes, worth 65¢ a bushel.

Review pages 1 to 12.

1. What is a unit?

2. What is notation?

3. Why is our system of notation called the Arabic system? Why is it called a decimal system?

4. What is numeration?

5. What do you mean by the *place value* of a figure?

6. Name the first five periods. Name in order the first six decimal places.

7. Read 3,010,004,300.03.

8. Write in figures, forty-six billion, seventy million, six thousand six and one thousand two hundred five millionths.

9. Name the result of an example in addition.

10. Show by example when the result of subtraction should be called a difference, and when it should be called a remainder.

11. What is a concrete number? Give an illustration.

12. Name the terms used in multiplication.

13. When the multiplicand is an abstract number, what will the product be?

14. Give two definitions for division. Illustrate each definition by an example.

15. Name the terms used in division, and give an example illustrating the use of each.

16. What is the effect on the quotient of multiplying the divisor by 2?

17. In what other way may the same effect be produced?

18. Show that multiplication is a short process of addition.

19. How do you check the work in multiplication?

20. Divide 432,089,052 by 475,869.

21. Multiply 487,653,879 by 5,086,009.

22. From 7,009,560,001 take 1,974,685,745.

23. Add 7086; 9; 170,094; 32; 5; 702; 4,005,019; 12; 807.

Review Lessons 15 to 17.

1. What is a factor?

2. What are the factors of 12? 18? 24?

3. What is factoring?

4. What is a prime number? Give an illustration.

5. What is a composite number? Give an illustration.

6. Find the prime factors of 3645. Of 9768.

7. Name a multiple of 7. Name a multiple of 7 that is also a multiple of 3.

8. What do you mean by the least common multiple?

9. Find the least common multiple of 45, 63, 72, 99.

10. Name a divisor of 14. Name a divisor of 49 that is also a divisor of 14.

11. What do you mean by greatest common divisor of two or more numbers?

12. Find the greatest common measure (divisor) of 36, 84, 132.

13. What is cancelation? Where should you use it in your work?

14. How many times as much will a box contain whose dimensions are $11'' \times 27'' \times 30''$, as one whose dimensions are $6'' \times 9'' \times 15''$?

15. Of what advantage is cancelation in example 14? On what principle is it based?

16. What is a fraction?

17. Name the terms of a fraction and tell what each term indicates.

18. Define a proper and an improper fraction and give an illustration of each.

19. What is meant by reduction of fractions? On what principle is it based?

20. Reduce $\frac{4}{15}$ to 60ths. $\frac{36}{144}$ to lowest terms. $12\frac{1}{2}\frac{1}{4}$ to an improper fraction. $\frac{578}{72}$ to a mixed number.

Review Lesson 18 to 29.

1. What are similar fractions?

2. To what must we change $\frac{2}{3}$ and $\frac{3}{5}$ before we can add or subtract them?

3. Add $52\frac{2}{3}$ and $61\frac{1}{8}$. Subtract $39\frac{1}{3}$ and $24\frac{7}{12}$.

4. A man had a farm of $125\frac{1}{4}$ acres. He planted $3\frac{3}{8}$ acres with potatoes, $4\frac{1}{2}$ acres with corn, and $9\frac{3}{4}$ acres with oats. If the rest of the farm was equally divided between pasture and mowing, how many acres of mowing were there?

5. State the two ways for multiplying a fraction by an integer.

6. Which method would you use in multiplying $\frac{8}{9}$ by 3? In multiplying $\frac{5}{7}$ by 2?

7. How do you multiply a fraction by a fraction?

8. Multiply $4\frac{2}{9}$ by $27\frac{1}{8}$.

9. Find the cost of $345\frac{3}{8}$ M. of pine flooring @ $\$32\frac{3}{4}$.

10. State the two ways of dividing a fraction by an integer.

11. Which method would you use in dividing $\frac{14}{15}$ by 7? In dividing $\frac{3}{5}$ by 2?

12. How do you divide an integer by a fraction?

13. Divide $142\frac{1}{2}$ by 5. Divide 8 by $3\frac{4}{5}$.

14. Divide $\frac{3}{4}$ by $\frac{5}{2}$. What change do you make in these fractions before dividing?

15. A field contains $1079\frac{7}{8}$ sq. rd. One side is $40\frac{3}{4}$ rd. long. The other side is —— rd.

16. State the rule for dividing a fraction by a fraction without changing them to similar fractions.

17. Express $3 \div 4$ as a fraction.

18. Express $\frac{2}{3} \div \frac{3}{4}$ as a fraction.

19. What is a complex fraction? How may it be changed to a simple fraction?

20. What change is made in the value of a fraction by dividing the numerator by 3?

Review Lessons 30 to 34.

1. Name the first eight decimal places.

2. Read .0001005.

3. Multiply 5.005 by 1000. How did you do it?

4. How would you divide 15.02 by 100?

5. What decimal place is occupied by hundredths? By ten-thousandths? By millionths?

6. A unit consists of how many tenths? Of how many thousandths?

7. A cent consists of how many tenths? A tenth of a cent is called what?

8. How should decimals be arranged for convenience in adding and subtracting?

9. If a man has 101.8 acres of land and buys 51.75 acres more, how many acres will he then have?

10. If this man then sells 25.25 acres, how many acres will he then have?

11. Give the rule for multiplying a decimal by a decimal.

12. How does the number of decimal places in the product compare with the number in the multiplicand and multiplier?

13. When dividing a decimal by a decimal what change is first made in the position of the decimal points?

14. How does the number of decimal places in the quotient compare with the number in the divisor and dividend?

15. How do you change a decimal fraction to a common fraction?

16. Change .0375 to a common fraction in its lowest terms.

17. How do you change a common fraction to a decimal?

18. Change $5\frac{4}{5}$ to a mixed decimal.

19. What will 4280 ft. of boards cost at $21.75 per M?

20. At 15¢ per C, what is the freight on 7875 lb. of plaster?

21. Find the cost of 7486 lb. of coal at $5.65 a ton.

22. Find the cost of 8798 ft. of timber at $14.70 per M.

Review Lessons 35 to 39.

1. What does 6% mean?

2. Write $12\frac{1}{2}$ per cent using the sign of percentage. Write it as a decimal fraction and as a common fraction.

3. What is percentage?

4. Name the three cases in percentage. Make examples illustrating each case.

5. A farmer takes 420 lb. of milk to a creamery and is paid 21¢ a pound for the butter fat. If the butter fat is 3.6% of the weight of the milk, how much does he receive?

6. A house worth \$7200 is insured for $\frac{3}{4}$ of its value. If the rate for insuring is 60¢ on \$100, what sum must be paid?

7. Change $\frac{1}{4}$% to a decimal. Change .005 to a per cent.

8. 75 is 15 per cent of what number?

9. If the ore is 35% pure, how much iron will 6893 lb. of ore produce?

10. Given the cost of an article and the rate of gain. What can you find? Illustrate by an example.

11. Given the selling price and the loss per cent. What can you find? Illustrate by an example.

12. A man paid an agent \$65 for collecting a bill. If he paid the agent $2\frac{1}{2}$% of all he collected, what did the agent collect?

13. A livery man bought two horses at \$125 each. In selling he lost 20% on the first and gained 25% on the second. How much did he gain in all?

14. A owns 45% of a factory worth \$48,000, B owns $36\frac{1}{2}$% of it, and C owns the remainder. What is the value of each of their shares?

15. What sum of money less 7% of itself is \$483.60?

16. There are 20,880 pupils in school. If this is 36% of the entire population, what is the population?

17. A commission merchant sold 540 bbl. of flour at \$6.37$\frac{1}{2}$ a barrel. Find his commission at 3%.

Review Lessons 40 to 44.

1. In every bill who is the creditor? Who is the debtor?

2. What should each item of a bill give?

3. What do you mean by the footing of a bill?

4. Mr. Covert bought of the Cash Grocery Store, Aug. 2, 4 lb. 8 oz. of steak @ 22¢; 2 lb. 9 oz. lamb chops @ 16¢. Aug. 4, 1 lb. 4 oz. sausages at 20¢; 4 lb. 9 oz. beef @ 24¢. Aug. 6, $8\frac{1}{4}$ lb. turkey @ 20¢. Make out the bill and receipt it.

5. As clerk for the Cash Grocery Store, write for Mr. Covert a receipt in full.

6. Rule paper and write the following as a cash account: Mr. Crowell bought a 200-acre wood lot at $12 an acre. He paid 36 men $1.50 a day for 24 days' work at cutting. He sold 260 cords @ $3.25, and 480 cords @ $3.75. He then sold the lot for $900.

7. Make out a pay roll when the hours a day and wages an hour are as follows: A, 8, 9, 9, 8, 9, $8\frac{1}{2}$, 26¢; B, 9, 8, 9, 9, 9, $8\frac{3}{4}$, 32¢. C, 7, 8, 8, 0, 6, 8, 30¢. D, 8, 8, $8\frac{1}{2}$, $7\frac{3}{4}$, 8, 8, 36¢.

8. Give the rule for finding the area of a rectangle.

9. How many square rods are there in a rectangular field 36 rd. long and 24 rd. wide?

10. How do you find one dimension of a rectangle when you know the other dimension and the area?

11. The area of a rectangular field is 20 acres. If its width is 40 rd., what is its length?

12. How do you find the volume of rectangular solids?

13. Find the contents of a rectangular prism $20' \times 14' \times 10'$.

14. What measures would you need to know to find the square feet in the walls and ceiling of this room?

15. Take the measurements and find the square feet of surface in the six sides of the room.

16. What will it cost at $1\frac{1}{8}$¢ a square inch to polish the sides and top of a granite shaft 6 ft. high, if the width is 2 ft. and the thickness 22 in.?

Review Lessons 45 to 50.

1. What is an angle?

2. How many degrees are there in a right angle?

3. When will the hands of the clock form an angle of 60°?

4. What is a triangle? How many sides and angles has it?

5. How do you find its area?

6. A field is in the form of a triangle. Its base is 120 rd. and its altitude 40 rd. It contains —— acres.

7. The area of a triangle is 7 sq. yd., and the altitude is 21 ft. What is the base?

8. Each side of an octagonal (8-sided) pyramid is a triangle. Its base is 12 ft., and its altitude is 75 ft. How many square feet are there in all the sides? Find the cost of painting it at 20¢ a square yard.

9. A barn is 90 ft. long, 45 ft. wide, and 30 ft. high to the eaves. The height of the gable is 15 ft., and the rafters are 30 ft. long. Using a scale of 1 in. to 15 ft., make a drawing to represent the barn as on page 48.

10. Find the number of feet of boards needed to cover the roof and sides.

11. Find the number of feet of lumber needed for the floor covered with 2-in. plank.

12. What is the ratio of the circumference of a circle to its diameter? How is it represented?

13. What dimensions of a circle do you need to know in order to find its area? How do you find the area?

14. Draw a circle with a radius of 5 in., to represent a lot of land. If the scale is $\frac{1}{4}$ in. to a rod, how many square rods are there in the field? How many acres?

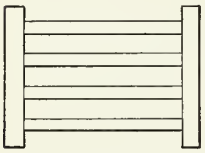
15. A wheel whose diameter is 3 ft. turns how many times in going a half-mile?

16. It is 75 ft. in a straight line from where I am standing across a circular pond. How far must I walk to reach the point directly opposite?

Review Lessons 51 to 59.

1. Find the cost at \$30 per M for 20 joists, each 18 ft. long, 5 in. wide, and 3 in. thick.

2. A rectangular field is 36 rd. long and 162 ft. wide. If posts are placed 9 ft. apart, how many will it take? Find their cost at \$35 per C.



3. This represents one panel of the fence round this field. If the boards are 6 in. wide, find the cost of lumber for the fence at \$15 per M.

4. What is the value of a pile of wood $40' \times 4' \times 5\frac{1}{2}'$ at \$5.50 a cord?

5. A bin will hold 448 bu. of apples, how many cubic feet does it contain? If the bin is 10 ft. long and 7 ft. wide, how deep is it?

6. If a cubic foot of coal weighs 90 lb., how many cubic feet must a bin contain to hold 15 tons? If the bin is 10 ft. long and 4 ft. wide, how deep is it?

7. If a tank is 4 ft. long and 3 ft. wide, how deep is the water in it if it contains 200 gallons?

8. How do you find the number of breadths of carpet needed for any room?

9. How many yards of carpet 27 in. wide will be needed for 3 rooms measuring $22' \times 15'$, $18' \times 15'$, $10\frac{1}{2}' \times 9'$?

10. At \$2.25 a yard find the cost of carpet 27 in. wide for a room $26' \times 11'\ 3''$.

11. At \$1.25 a yard find the cost of carpet $\frac{3}{4}$ yd. wide to cover a floor 27 ft. long, 16 ft. wide. The breadths run lengthwise, and there is a loss of 3 in. on each breadth for matching.

12. I wish to carpet a room 20 ft. by 18 ft. with carpeting $2\frac{1}{4}$ ft. wide. How much shall I save by laying the carpet crosswise instead of lengthwise, if the carpet costs \$1.90 a yard?

13. How much will it cost at 36¢ a square yard to plaster the walls and ceiling of a room $18' \times 14' \times 9'$, deducting 180 square ft. for openings?

Review Lessons 60, 61, 113, 114, 115.

1. A farmer picked 3 times as many russets as greenings and as many baldwins as russets and greenings. In all he picked 96 barrels of apples. How many of each kind did he pick?

2. A bookseller sold a number of books one day, 4 times as many the next day, and on the third day 2 times as many as on the first day. In all he sold 252 books. How many did he sell each day?

3. Divide 64 into two parts, so that one part shall be 3 times the other part.

4. Two numbers are to each other as 3 to 5, and their sum is 128. Find the numbers.

Find the value of x:

5. $6x + 6 = 24$
6. $3x - 6 = 10$
7. $3x + 3 = 12$
8. $4x - 7 = 9$
9. $5x + 5 = 15$
10. $4x - 3 = 17$

11. Seven times a number increased by 3 times the number is 50. Find the number.

12. Eight times a number, divided by 2, is 16. What is the number?

13. One eighth of the sum of a certain number and 18 is 34. What is the number?

14. A certain number increased by 5 equals 11. What is the number?

15. A newsboy sold a certain number of papers on Monday, and 10 more on Tuesday than on Monday. In all he sold 42 papers. How many did he sell each day?

16. Charles has 64 cents, which lacks 16 of being 5 times as many as Arthur has. How many cents has Arthur?

17. A line 45 inches long was divided into 2 parts, one of which was 12 inches longer than the other. How long is each part?

Review Lessons 62 to 71, 101.

1. What is interest? Principal? Amount?

2. Find the interest on \$1000 for 3 yr. at 5%.

3. Write a promissory note, making yourself the maker, and your teacher the payee.

4. How do you find the interest at 6% on any sum of money for 2 mo. or 60 d.?

5. When you know the interest for 2 mo., how would you find the interest for 10 mo.? 1 yr. 4 mo.?

6. When you know the interest for 60 d., how would you find the interest for 30 d.? 15 d.? 20 d.?

7. Find the interest on \$625.80 from Nov. 28, 1909, to Sept. 16, 1911, at 6%.

Find the interest on:

8. \$4,763.25 for 1 yr. 9 mo. 13 d. at 7%.

9. \$485.16 from Aug. 3, 1909, to Nov. 17, 1910, at 5%.

10. \$864 from Mar. 10, 1909, to Aug 30, 1911, at 4%.

11. \$1700 for 28 days at 8%.

Find the amount of:

12. \$2679.13 from June 6, 1910, to July 6, 1912, at 7%.

13. \$4163.17 from April 11, 1909, to July 1, 1911, at 6%.

14. \$162.50 from Aug. 16, 1910, to Nov. 29, 1911, at 4%.

15. I borrowed \$500 from a friend, promising to pay 6 cents a year for every dollar I borrowed. If I kept his money 3 yr. 3 mo., how much must I pay for the use of it?

16. I borrowed \$350 at 6% interest, Oct. 10, 1909. How much shall I owe Jan. 1, 1912?

17. A farmer sold 19½ tons of straw at \$15½ a ton, and took a note at 6% in payment. Write the note. If the note was paid in 90 days, how much did he receive?

18. May 1, 1909, I borrowed \$364, and Feb. 7, 1911, I paid it back with interest at 6%. How much did I pay?

Review Lessons 72 to 79.

1. A merchant sold goods which cost him \$4,768.75 at a profit of 18%.

2. A man raised 1640 bu. of grain and sold 246 bu.

3. A grocer bought \$400 worth of oranges, 25% spoiled before he sold them. The remainder he sold at $16\frac{2}{3}\%$ above cost.

4. A farm which cost \$3400 was sold at a gain of 22%.

5. \$1500 was on interest 1 yr. 3 mo. 27 d. at 6%.

6. A man bought 120 acres of land at \$60 an acre and paid 25% of the cost of the land for buildings. The next year he sold at a gain of \$2000.

7. Some 4 ft. wood is piled 6 ft. high. The pile contains 24 cords.

8. A man built a house costing \$3500 on a lot which cost \$600. The house burned and the insurance company paid him 80% of the cost of the house. Then he sold the land at an advance of 80%.

9. An article that cost \$75 was sold for \$95.

10. If 12 men build a wall in 8 days, how long will it take 16 men?

11. Find the entire surface of a rectangular column whose altitude is 12 ft. and base 18 in. by 14 in.

12. At \$1.40 a yard find the cost of carpeting a room 21 ft. by 16 ft. with carpet $\frac{3}{4}$ yd. wide. The breadths run crosswise and there is a loss on each breadth of 1 ft. for matching.

13. A rectangular lawn measures 15 yd. 2 ft. in length and 33 ft. 8 in. in width. At 75¢ a square foot find the cost of sodding the lawn.

14. Find the number of square feet in a walk 3 ft. 8 in. wide running round the outside of the lawn in example 13.

15. Find the cost of 1860 ft. of lumber at \$24.50 per M.

16. If I pay $\$4\frac{2}{5}$ for $5\frac{1}{2}$ lb. of tea, what must I pay for $9\frac{7}{8}$ lb. at the same rate?

Review Lessons 80 to 82.

1. What are compound denominate numbers?

2. What do you mean by reduction of compound numbers?

3. Write the table of Liquid Measure.

4. How many gallons of water will fill a cubic foot?

5. Write the table of Dry Measure.

6. How many cubic feet are there in an even bushel? In a heaped bushel?

7. When is the even bushel used? The heaped bushel?

8. Write the table of Long Measure.

9. Give the length of a fathom, a knot, a league. Where are these measures used?

10. Write the table for Square Measure.

11. In many unsettled parts of the country the land is divided into sections instead of townships. How many acres are there in each section?

12. Write the table of Cubic Measure.

13. How many bricks are estimated as equal to one cubic foot?

14. How many bricks are there in a wall 18 ft. long, 9 ft. high, and 18 in. thick?

15. What are the dimensions of a brick?

16. How many bricks will it take to cover a sidewalk 12 ft. by 3 ft.?

17. Write the table of Avoirdupois Weight.

18. How many pounds are there in a long ton?
Where is the long ton used?

19. A dealer bought 425,600 lb. of coal at $2.75 a long ton and paid $.85 a ton for freight. He sold it at $5.50 a short ton and paid $.25 a ton for delivery. How much did he make?

20. Write the table for Time Measure.

21. Write the table for United States Money.

Review Lessons 83 to 91.

1. Write the tables for counting.

Change:

2. 17 yards to inches.
3. 7.8 mi. to feet.
4. 2.25 mi. to rods.
5. 960 rods to higher units.
6. 720 in. to yards.
7. 750 ft. to yards and feet.
8. 35 sq. yd. to square inches.
9. 23,958 sq. ft. to sq. rd.
10. 42 cu. yd. to cu. ft.
11. 6912 cu. in. to cu. ft.
12. 3 T. 700 lb. to pounds.
13. 64,000 oz. to tons.
14. 396 gi. to quarts.
15. 76 gal. to pints.
16. 16 d. to hours.
17. 252 hr. to days.
18. 19 hr. 18 min. 15 sec. to seconds.

19. How many acres are there in 609,840 sq. ft.?

20. A box of butter weighed 15 lb. 10 oz. If the box weighed 3 lb. 2 oz., find the value of the butter at 30¢ per pound.

21. If a rail is $16\frac{1}{2}$ ft. long, how many rails will it take to lay a railroad track 2 mi. 100 rd. long?

22. A farmer had 750 bu. 1 pk. of potatoes and put them into barrels, each barrel holding 2 bu. 1 pk. How many barrels did it take?

23. Divide 19 lb. 2 oz. by 3.

24. What part of 2 gal. is 2 qt. 1 pt.?

25. From 24 mi. take 17 mi. 88 rd.?

26. Multiply 10 cd. 13 cu. ft. by 12.

27. If a car runs 18 mi. 140 rd. in $\frac{1}{2}$ hr., how far will it run in 12 hours?

28. What is the area of a rectangular field 8 rd. 10 ft. long and 6 rd. 8 ft. wide?

29. Divide 17 hr. 32 min. by 4.

30. Change $\frac{7}{8}$ of a ton to pounds.

31. What will $\frac{1}{2}$ mile of fence cost at $1.50 a rod?

Review Lessons 98, 99, 117, 118.

1. What is the square of a number?

2. Write the squares of all the numbers from 1 to 12.

3. $(17)^2 =$ ——. In this example what is the figure 2 called? What does it tell us?

4. $(49)^2 =$ ——. 5. $(87)^2 =$ ——.

6. Find the square of 1001.

7. Find one of the two equal factors of 81.

8. Finding one of the two equal factors of a number is called finding the —— —— of the number.

9. A square measures 25 rd. on a side. It contains —— sq. rd.

10. At \$50 an acre find the cost of a square field measuring 40 rd. on a side.

11. A farmer has a lot 40 rd. long, 20 rd. wide. What is 35% of it worth at \$80 an acre?

12. How many pickets 3 in. wide and nailed 3 in. apart will it take to fence a lot 4 rd. long and 10 rd. wide?

13. A well is 22 ft. deep and 5 ft. in diameter. How many cubic feet of water are there in it if it is $\frac{2}{3}$ full?

14. What is the difference in volume between a square prism 7 in. wide and 25 in. long and the largest cylinder that can be cut from the prism?

15. Comparing the area of the base of the cylinder with that of the prism, we find it to be a little more than $\frac{3}{4}$ of it. What then must be true of the volume of the cylinder compared with that of the prism?

16. If every cylinder is about $\frac{3}{4}$ the volume of a prism having the same dimensions, find approximately the volume of a cylinder whose diameter is 9 in. and altitude 20 in.

17. Find approximately the volume of a cylinder whose diameter is 21 in. and altitude 42 in.

18. A cylinder is 3 ft. 8 in. long and has a diameter of $1\frac{1}{2}$ ft. How many gallons will it hold?

Review Lessons 108 to 112.

1. What is ratio?

2. Express the ratio of 9 to 3 in three ways.

3. How do you find the ratio between two numbers?

4. Name the terms of a ratio.

5. A and B together have \$84. If A's money is to B's as 4 to 3, how much money has each? Solve this problem by ratio, then solve it by algebra.

6. What is proportion?

7. Write a correct proportion.

8. $6 : 3 = 8 : 2$. Is this a correct proportion? Prove your answer in two ways.

9. What are the terms of a proportion? What must be true of the terms?

10. The antecedent of the second ratio is what term of the proportion?

11. Write four proportions having a different term missing in each. Find the missing terms.

12. If 35 acres of land cost \$927.50, what will 175 acres cost? Is this a direct or inverse proportion?

13. If 9 men can build a wall in 15 days, how long will it take 5 men to build it? Is this a direct or inverse proportion?

14. If it requires 42 yd. of carpeting $\frac{3}{4}$ yd. wide to cover a floor, how many yards $\frac{7}{8}$ yards wide will cover the same floor?

15. If a train travels 220 mi. in 8 hr., how long will it be in traveling 330 miles?

16. If $2\frac{3}{4}$ yd. of cloth can be bought for \$3.30, what will $15\frac{7}{5}$ yd. cost?

17. What will $94\frac{1}{5}$ yd. of cloth cost, if $165\frac{1}{3}$ yd. cost \$74.40?

18. If $\frac{7}{8}$ of a pound of tea cost 63 cents, what will $132\frac{1}{2}$ lb. cost?

19. If \$2.80 will buy $\frac{7}{8}$ of a ton of coal, how much coal can be bought for \$1.60?

1. If 5 yd. of cloth are worth 80 cents, how much is $\frac{5}{8}$ of a yard worth?

2. If 4 men can do a piece of work in 6 days, how long will it take 12 men to do the same work?

3. $\frac{3}{5}$ of 80 is what per cent of $\frac{1}{2}$ of 120?

4. If $\frac{3}{4}$ of a ton of coal is worth $\$3\frac{3}{4}$, how much are $3\frac{1}{2}$ tons worth?

5. From what number may 8 be taken 3 times and leave 3 as a remainder?

6. A rectangular field contains 1 acre. If it is 40 rd. wide, what is its perimeter?

7. How must a merchant mark cloth that cost 12¢ a yard so as to gain 25%?

8. What per cent of an acre is a rectangular lot 4 rd. by 5 rd.?

9. A gain of \$5 on goods that sold for \$25 is a gain of what per cent?

10. How much will a 40 qt. can of milk cost @ 24¢ a gallon?

11. A river is 60 ft. deep. How many fathoms deep is it?

12. How far must a man travel in a day, to travel 133 miles in a full week?

13. A watch cost \$40 and a chain cost \$12. What per cent of the cost of the watch is the cost of the chain?

14. Find the cost of 1000 cd. of wood at $\$5.12\frac{1}{2}$ a cord.

15. A man earned \$100 a month. If he spent \$4 out of every \$10, how much could he save in a year?

16. What will 27 lb. of coffee cost at $33\frac{1}{3}$¢ a pound?

17. Add all the prime numbers between 1 and 10.

18. How many hours is it from 2.45 P.M. to 5.15 P.M.?

Name two factors of each of the following numbers:

19.	45	48	49	50	54	55	56
20.	81	88	96	108	121	132	144

1. Multiply .8 by .96. Divide 2.048 by .00512.
2. Find the least common multiple of 28, 32, 56, 76, and 96.

Find results:

3. $16 \div \frac{7}{15}$ of $2\frac{8}{11}$ of $\frac{11}{35}$.
4. $8\frac{3}{5} \div 6\frac{1}{7}$.
5. $23\frac{5}{8} + 32\frac{9}{8} + 18\frac{3}{4} + 27\frac{5}{6}$.
6. $64\frac{3}{4} - 28\frac{13}{16}$.

7. If 6 acres of land cost \$72, what will $\frac{2}{16}$ of 80 acres cost?

8. If $\frac{1}{8}$ of a certain number is 16 more than $\frac{1}{9}$ of it, what is the number?

9. What will it cost at 54¢ a cubic yard to dig a ditch 2 ft. deep and $1\frac{1}{2}$ ft. wide round a lot 4 rd. long and $3\frac{1}{3}$ rd. wide?

10. If a stick of timber $20' \times 12'' \times 10''$ is sawed into boards 1 in. thick, how many board feet will there be?

11. Write in words the denominator of a decimal of 4 figures. One of seven figures.

12. What will a merchant receive for 7400 yd. of cloth at $7\frac{1}{2}$ ct. a yard, if he deducts 15% from the bill?

13. What is the value of 12 pairs of shoes at \$3.25 a pair, less a discount of 5%?

14. How many cords of wood will a log make that is 3 ft. in diameter and 40 ft. long?

15. The area of a rectangle is 60 sq. yd. If its base is 120 ft., what is its altitude?

16. What is the cost of a pile of wood 27 ft. 6 in. long, 4 ft. wide, 11 ft. 3 in. high, at $\$5\frac{1}{4}$ a cord?

17. A horse and carriage cost \$660. The horse cost 5 times as much as the carriage. Find the cost of each.

18. An agent's salary was increased 30%. If he then received \$2600, what did he receive before the increase?

19. A man lost $\frac{2}{5}$ of his money and had \$411 remaining. How much had he at first?

20. A boy began to work at 9 A.M. In 10 min. he had done $\frac{1}{15}$ of his work. When did he finish?

1. Nellie has 45 cents and Grace has $\frac{5}{9}$ as many. How many cents has Grace? How many have both?

2. If $\frac{1}{3}$ of a barrel of sugar costs \$3, what will $2\frac{2}{3}$ barrels cost?

3. Find the interest on \$500 from Jan. 1, 1910, to July 1, 1911, at 6%.

4. How many square yards are there in a floor that is 12 ft. square?

5. If an article that costs \$600 is sold at a gain of 1%, what is the gain? What would be the gain at $\frac{1}{3}$ of 1%?

6. $\frac{1}{8}$ of 40 is what per cent of $\frac{1}{2}$ of 20?

7. When is the selling price more than the cost? When is it less?

8. Find the change due from 3 dimes for a 27¢ purchase.

9. What number added to twice itself gives 18?

10. In a pile of wood there are 24 cords. If $\frac{3}{8}$ of the pile is worth \$54, what is 1 cd. worth?

11. 54 is how many times $\frac{3}{8}$ of 24?

12. How many cubic feet are there in a wall 30 ft. long, 4 ft. high, and 2 ft. thick?

13. How many one-foot cubes can be placed in a cubical box, one yard long, one yard wide, and one yard high?

14. Divide 30 d. 15 hr. 45 min. by 3.

15. What name can you give to any figure having four sides?

16. A pile of oats weighs 96 lb. How many bushels are there?

17. A fishpole is 12 ft. long. If it was 3 ft. longer, it would be $\frac{5}{8}$ as long as the line. How long is the line? How long are both line and pole?

18. If school begins at 1.45 P.M. and closes at 3.30 P.M., how many minutes are there in the afternoon session?

19. A man had \$180, and gave $\frac{2}{9}$ of it away. If he spent $\frac{3}{7}$ of the remainder, how much had he left?

1. Four men cut a pile of wood. If the first man cut $\frac{1}{4}$ of it, the second $\frac{1}{3}$, and the third $\frac{3}{8}$, how much did the fourth cut?

2. If $1\frac{1}{4}$ lb. of beef and $1\frac{3}{8}$ lb. of flour are allowed to each man as a ration, how much will rations for 618 men cost if beef is 15¢ a pound and flour $3\frac{1}{2}$¢ a pound?

3. If $\frac{3}{4}$ of a farm is valued at \$2,253.30, what is the value of $\frac{2}{3}$ of it?

4. If an angle measures 45°, what part of a right angle is it?

5. A man bought 6 boards, each 16 ft. long and $1\frac{1}{2}$ in. thick. Their widths were as follows: 8 in., 9 in., 10 in., 12 in., 13 in., 14 in. How many feet of lumber did he buy?

6. Find the entire surface of a 9-in. cube.

7. A boy gave his brother Charles $\frac{2}{7}$ of his marbles and to Henry $\frac{3}{5}$ of the remainder. Henry received 7 more than Charles. How many did each receive?

8. Write the following as per cents, using the sign: .08, .025, 1.05, .00$\frac{1}{2}$, .06$\frac{1}{4}$, $\frac{3}{10}$, $\frac{7}{12}$, 3.75, .0045, 4.5.

9. Add the product of 7.1 and 7 ten-thousandths to 9 hundredths.

10. Find the interest on \$575 from Sept. 14, 1911, to March 2, 1913, at 4%.

11. A grocer bought 40 doz. cans of corn listed at \$1.10 a dozen. He was allowed a discount of 20%. What was the net price? The *net price* is the cost after the discount has been deducted.

12. At \$7.50 a thousand, what will the bricks cost for a wall 80 ft. long, 6 ft. high, and 1 ft. thick?

13. Find the weight of a block of marble 3′ 8″ long, 2′ wide, and 1′ 3″ thick, if its specific gravity is 2.7. This means it is 2.7 times heavier than water, and a cubic foot of water weighs $62\frac{1}{2}$ lbs.

14. Find the number of yards of carpet 27 in. wide needed for a room 17 ft. 8 in. long and 15 ft. 4 in. wide.

1. The end of a building measures 27 ft. in width and 18 ft. to the eaves. The height of the gable is 9 ft. Using a scale of $\frac{1}{2}''$ to 9 ft., make a drawing to represent the end of the building.

2. If the wind exerts a pressure of 9 lb. 8 oz. upon each square foot of surface, what is the total wind pressure against the end of the building?

3. This building is 36 ft. long and the rafters are 16 ft. long. Find the weight of snow on the entire roof, if the weight on each square foot of surface is 18 pounds.

4. Write the following data as a cash account:

Mar. 10, Paid for 5 d. labor @ \$1.25; 100 bu. seed oats @ 38¢; $6\frac{1}{2}$ d. work ploughing @ \$1.25. Aug. 15, Paid for cutting 40 acres of oats @ 75¢; Sept. 5, Threshing 1864 bu. oats @ 3¢; 4 d. help in threshing @ \$1.50. Dec. 10, Received pay for 1650 bu. oats @ $28\frac{1}{2}$¢; 74 loads straw @ \$5.50.

5. A lawn tennis court, $78' \times 36'$, has on each side a strip of sod 9′ wide and on each end a strip 18′ wide. What will the sod cost at 27¢ a square yard? Make a diagram to illustrate.

6. An automobile running 36 mi. an hour meets another running in the opposite direction 24 mi. an hour. At what rate do the two automobiles approach each other?

7. If the automobiles in example 6 are 10 miles apart at 9 A.M., when will they pass each other?

8. Answer questions 6 and 7 for two automobiles running at the given speed in the same direction.

9. Two numbers are to each other as 2 to 7. If their difference is 65, find the numbers.

10. The sum of a number and half of the number is 60. What is the number?

11. The radius of a circle is 7 in. The width of a rectangle of equal area is 7 in. What is its length?

12. The sum of two numbers is 42 and their difference is 6. Find the numbers.

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